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GENERAL EDITOR — C. K. OGDEN, M.A.
(Magdalene College, Cambridge)

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IN PREPARATION

[illegible]

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by
SCOTT BUCHANAN

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POSSIBILITY

INTRODUCTION

The life of man might be portrayed as a series of rebirths, each of which consists in a passage from one world into another. The state of affairs at any given instant is an unstable equilibrium between opposing forces and values. One lives in one world and believes in another, suffering this and at the same time expecting or desiring that. It would seem highly important to know which world this is, and to be able to describe that. But most of us are hard-pressed when we are compelled to do so. Even poets and prophets, whose business it is to speak of such matters, admit the difficulty.

Some years ago Walter De la Mare wrote an essay on the *Intellectual Imagination*. It was originally an address at Eton on the occasion of a memorial service to Rupert Brooke. It was an attempt to capture the spirit of a young man who died before his poetry had disclosed the height and depth of the world in which he lived. What he had expressed was enough to place him among those artists, who instead of taking permanent flight from this world, are content to see the commonplace in the shifting cresslights

of the ideal. The result was an intellectual insight which only philosophers are supposed to achieve in rare moments of clarity.

The majority of persons achieve something less. The other world is for them a heaven, sometimes distant and unreal, at other times just round the corner. If it is near, they are bold, shrewd, obstinate, fanatic. If it is far away, they are timid, diffident, uncertain, apologetic. They are at the extremes of the Aristotelian measures of virtue. Most of us vary along this scale. In moments of naïve enthusiasm heaven is around us, the child believes in fairies, the middle-aged man sees himself as saviour of the world, the old man dreams dreams. In moments of sophisticated review of our adventures, our persistent disposition to seize the unseen heaven takes on the sinister guise of a fatal credulity, rendering us subject to the whims of a malevolent and deceitful Cartesian demon. The belief in a heaven easy to attain is the cause of a hell on earth. At such times faith often turns into rage at a world that does not allow the prophet's vision to come true, or into self-condemnation for our childish fancies. We appear in the true colours of a citizen of an otherworldly kingdom. Such is the dialectic of man's knowledge and faith. One may as well submit and resolve to make the best of two worlds, heaven and earth, illusion and certainty,

imagined happiness and real disappointment, possibility and actuality.

Unfortunately, our present culture is not so simply black and white. It is rather a scene of many possible worlds with all degrees and kinds of value claiming our consideration. This aspect of things causes certain temperaments to hasten transmigration and to multiply rebirths in the hope that breadth of experience will teach stability in the end. To other temperaments this is dissipation of mind, and recourse is sought by another route to a place of vantage from which all may be seen in perspective. This latter, I take it, is the philosopher's temperament and mood. It is his duty to be "the good shepherd of his thoughts" and let wool-gathering take care of itself.

This essay takes this task seriously, yet, I hope, lightly. It takes the position of the bewildered individual seeking an intellectual way of life. In philosophy this is called methodology, and I am ambitious enough to seek a general methodology, not merely for this or that discipline, but rather an organon of intellectual imagination. It may not lead to future discovery or invention, but it may bring peace of mind in the present confusion, a zone of calm in the storm of doctrines.

As has been indirectly intimated, the other worlds are to be called possibility.

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By way of tentative definition, we shall assume three kinds of possibility—imaginative, scientific, and absolute. The first is the realm of fancy and imagination, expressed in the fine arts and literature; the second is the field of science as the ordered elaboration of systematic concepts applicable in experience; the third is written about in books by philosophers and theologians. I shall disentangle these by means of illustration and superficial analysis: next give a definition of possibility and show its place in our knowledge; then apply the definition in two great historical philosophies where possibility has played a deciding role; answer the charge of vicious teleology that is often entered against the use of possibility; and finally state a project of critical scholarship based upon the method derived from the preceding.

The outcome will not be the solution of any problems, unless a method of criticism can be so understood. I do not lay claim to originality, erudition, nor accurate scholarship. The time is not ripe, if it ever was, for system making. At any rate, much imaginative groping is necessary before this generation of philosophers can speak with authority. Only a faith in the possibility of understanding is necessary for a beginning, and there is the hope that intellect will discipline itself. A certain flippancy is not

to be taken as philosophic cynicism; humour is the sentiment specific to philosophy and I hope a decent sign of youth at work.

The philologist could, no doubt, tell an interesting story about the verbal alchemy that lies back of this term possibility. Even in contemporary usage there are transmutations from the gossamer abstractions of "mere possibility" to the powerful connotations of the "potential" and the "dynamic", and thence to the expansiveness of the "all possible" and the "Omnipotent". Latin and Greek words conspire to mislead the unwary discourser; even God Humself is caught in these particular meshes of the linguistic net. It would be the strenuous task of a mature scholar to straighten the tangle. I shall be fortunate indeed if I can avoid some of the ambiguities.

This essay does not belong to the field of historical scholarship in philosophy. If it did, it would presuppose a study which has not yet been made. Such a work may exist, but I am not acquainted with it. If it does exist, it is a history of the concept of possibility. It contains reference to and criticisms of historical instances of the use of the concept. It doubtless is a valuable and interesting contribution to scholarly thought. It might demonstrate the superfluity or worthlessness of the present undertaking.

However that may be, I know of no such work, and I feel keenly the need of some critical statement of the fundamental ideas involved in the use of possibility, both where it is recognized and in many more cases where it is used but not recognized, for instance, in contemporary scientific thought. Since my inclination and ability does not lie along the lines of historical research, I have chosen another mode of approach, namely the formulation of a theory which I find applicable in the methodology of contemporary thought and one or two outstanding cases of historical philosophy which concerned themselves with problems of method. It would be fortunate indeed to find that it is also capable of extension to wider historical fields.

Possibility is a peculiar idea. The more one reads the history of philosophy, the more mysterious it becomes. It is introduced usually in some off-hand way, as if by sleight-of-hand, at some crucial stage in the development of a theory, and often serves as at least a rhetorical saviour of the argument. It has been in some cases an ultimate of appeal, as for instance, in Aristotle. It is almost never defined, even when it holds a subordinate position in the system where definition would seem comparatively easy. It is almost as ubiquitous as the term substance and yet has received very little direct attention.

It is therefore in the limbo of semi-technical terms. Its history would seem to be worth writing, since it would involve working on that lively edge of encrusted doctrine where almost anything may turn up as relevant for comment and criticism.

By way of apology for not having done the job myself, it may be interesting to make some suggestions in the form of a hypothetical classification that one might use in collecting the material. This will also clear the ground for the thesis of this essay.

Possibility seems to have had three phases distinguishable in its historical uses. It is either real possibility, often called potency, power, or condition; or *ideal* possibility, often identified with logical consistency or compatibility; or metaphysical possibility, where either one or both of the preceding are universalised and we have a totality of conditions or an ultimate ground for all possible existence.

Some obvious points may be noted about each of these. The notion of real possibility has almost always been involved in scientific investigation and naturalistic explanation, or wherever material or efficient causes are sought. Aristotle called it potentiality and mediaeval naturalists followed him both in method and terminology. The view of possibility we shall develop shows the connexion between these ancestors of modern

science and their descendants who talk of matter and energy.

Ideal possibility appears to have a persistent affinity with mathematics and logic, and it seems relevant wherever formal and final causes are sought. The Platonic tradition would supply the earlier material for the study of this. But perhaps the most surprising discovery would be that modern idealism, without ever criticising the notion, has based its most daring arguments on this one kind of possibility to the exclusion of the former. The refutation of materialism, the coherence theory of truth, and the doctrine of internal relations are cases in point.

Not the least interesting of the episodes in the history of this concept are to be found in the recurrent issues in modern science. A great many controversies between the schools of science can be stated in terms of the two varieties of possibility above and their conflicting logics. The rather momentous shift in emphasis from Galilean mechanics to electro-magnetic theory in physics should be noted in this connexion, as well as the more recent attack of the Gestalt psychologists on the older traditions in that most controversial of all the sciences.

These conflicts between real and ideal possibility seem to have but one solution, that is in metaphysics, where one may become supreme by combining with the notion of

totality against the other. But whenever this happens, there you may look for a paradox. The union involves a sin against consistency, as we shall see later. It seems that one rival cannot survive without the other and yet both cannot survive together. Leibniz's possible worlds suffer defections from perfection, and God, the Omnipotent, is called in to arbitrate between them. The Absolute suffers internal contradiction until creative will or intelligence comes to its rescue. The naturalistic universe needs an intelligent Deity to keep it going or perform a miracle on occasion. Otherwise its parts remain unrelated or find themselves emerging into one another by the grace of God. In each of these cases God as infinite power or perfect consistency (total real possibility or total ideal possibility) is called in to function as a *deus ex machina* of a logical tragedy.

However, the crucial cases are not in theology and absolutistic philosophy. The so-called dynamistic ethics, where the good life is described as the realization of human possibilities furnish the best instance. This ethics has its source in Aristotle and its fullest exposition in idealistic theory. All the sciences are invited to contribute and each takes its place as a level or degree of possibility. Each is found wanting and partial, a one-sided ideal before it is realized

and merely the condition for higher development when it is fulfilled. The *summum bonum* is the totality of possibilities and ideals completely realized, a plenum of forms actualized. What was good Aristotelian physics applied to Greek life is here romantic rhetoric and sophistry. But out of it have come philosophies of the state, philosophies of law, philosophies of economics, philosophies of history, and philosophies of religion. These special theories are each embraced as complete incarnations of total ideal possibility and at the same time infinite extensions of real possibility, both habitations for the homeless absolute. They have had their good points as utopias do, that is as axes of reference and ideal frameworks for realistic investigations, but human hopes, however irrational they may be, have their limits and credulity has its regressions.

Recent developments in what is called metapsychology are interesting illustrations of this type of possibility. Freud and Jung, students of Janet whose methods were based on Leibnizian metaphysics, have found in it the conceptual support they needed for their clinical investigations. The *petites perceptions*, which were possible worlds in embryo, have become dynamic ideas, i.e. wishes, and, in general, libido or sex. These are inverted absolute ideals, or total possibilities, which the process of life fulfills, or more often is

condemned for not fulfilling, and the good life is defined as the greatest possible pleasure, or release of powers, which is compatible with the least possible restraint. Aristotle's right reason, or the right plan, for achieving happiness now becomes the "reality principle", and one is saddened to think how poor has life must be in comparison with all the pleasures that are possible.

Enough has been said to give the reader an intimation of the omnipresence of possibility in the history of philosophy at least. A great deal more might be added, but only a more detailed examination of it would make it profitable.

However, recent logical theory affords some typical illustrations of crucial applications of possibility and the hesitating manner in which it is treated. For instance, Mr. Johnson in his comprehensive and illuminating work on Logic makes some very interesting suggestions in at least two cases, but fails to see the argument through. Following the traditional classification, the chapter on Modality introduces the various meanings that the term possibility has had in that context. It is a term correlative with actuality on one hand, and with necessity on the other. He suggests that any kind of modality can be formulated in terms of a distinction between primary and secondary propositions. On this basis possibility

becomes an adjective predicated of primary propositions which serve as subjects in secondary propositions, as when we say: "It is possible that the sun is now shining in China." It is so predicated in at least two senses, (1) when ignorance of any true proposition incompatible with the given primary proposition allows tentative assertion of it, and (2) when the truth value of a given primary proposition is not definitely determined by implicative relations in a given system. Later these two meanings of possibility are illustrated in the logic of science where the formulation of causal explanation is considered. When some of the causes of a given phenomenon have been found and more are being sought, it is necessary to make tentative assertion of propositions whose truth value is not known either by observation or by deduction. Such propositions are taken to be possibly true. Such assertions are, of course, extremely common in the practice of science. The problem is to find the states of such propositions. The logician must go beyond the merely logistic analysis into primary and secondary propositions and state the case in a wider content. Possibility is then said to be equivalent to conceivability; anything that can be construed in thought is possible. Mr Johnson states this and stops, but it seems to me that he has stopped just where the problem

becomes important. The fundamental problem is to find out what we mean by conceivability, and the solution is only suggested when we classify the uses of terms and exhibit the logistic devices for analyzing the propositions in which they occur. In accordance with my interpretation we shall see that isolated propositions indeterminate with respect to truth value are typical cases of possibility. Systems themselves are isolated and indeterminate with respect to truth value. They are in Russell's terminology, incomplete symbols. We want to know what their nature is. I hope I can in this essay make good the promise which this criticism implies.

Another recent use of the concept of possibility is to be found in the theory of strict implication. According to this theory, implication is exemplified when we say that p implies q if it is impossible (inconceivable) that p be true and q be false. This is another case of the appeal to conceivability or the formal conditions of thought as equivalent to possibility, but no account is given to satisfy our curiosity about its meaning. In this case, as in the former, I am not objecting to the use of possibility as a basic concept in logic; with that I would agree. But such use of it further increases the need for some critical account of its anatomy and function, not only in logic, but also in other

fields of study. Nevertheless it is an interest in these problems that has led me to turn to methodology as the locus of the more general considerations that are necessary for their solution.

I have taken my cue from Kant. *The Critique of Pure Reason* is a treatise on possibility, and I believe its proper understanding is to be based upon the interpretation which follows from this assumption. More particularly, Kant's doctrine of modality is relevant. This will be more fully supported in the chapter on Kant. It will be sufficient here to state his formula for possibility and let it emphasize the thread of the argument to that point: "That which agrees in intuitions and concepts with the formal conditions of experience is possible." This formula is a summary of what may be called the postulates of this essay. It therefore partially fulfills the obligation laid upon writers of such essays by the present state of the intellectual arts. He must claim no dogmatic self-evidence for his view, confining his exposition to the proposal of a hypothesis and the elaborations of its consequences, leaving the judgment of its validity to the insight of the reader. A few explanatory comments on this formula will be sufficient to set us on our way.

First, I assume that our intellectual culture is constituted by a plurality of theoretic

systems. We are aware of this in a confusion that we often impute to reality, or, as the fashion has it, to the environment and civilization. The so-called application of intelligence in practical affairs most often verifies the imputation by discovering the unfitness of our ideas.

Secondly, each of these theoretic systems has a relative opaqueness. Our so-called knowledge seems to be a variety of mutually external universes of discourse which present themselves in the alternatives of dilemmas or antinomies. The ordinary intelligent layman as well as the professional intellectual entertains many such dilemmas; mechanism and vitalism, determinism and free-will, mind and body, reason and experience, the static and dynamic, natural and unnatural, pleasure and duty, tradition and liberty, and others. These are not simply instances of the dualism of possibility and actuality, but are points of conflict between systems. I assume that systems are wrongly accepted as external and opaque, that rather these fundamental dilemmas are tentative statements of successive problems in the dialectical treatment of ideas, and are soluble *symbolando*.

Thirdly, these solutions are possible because the systems have discoverable formal characteristics which are capable of mutual reference, directly or indirectly.

Fourthly, these formal properties are capable of analysis into elements which can be

treated abstractly and in isolation from the systems to which they belong in spite of the fact that they have unavoidable relations with other elements in the system. It is these formal characters that I identify with Kant's "intuitions and concepts" or possibility.

The elements I have called parameters. The term is taken from mathematical usage and is generalized to cover the variety of subject matters amenable to treatment in Aristotelian and mathematical logic, as well as in the methods of the various sciences and arts which have contributed to our intellectual culture. Possibility denotes the subject matter of methodology and parameters are its elementary constituents.

It will be seen that this essay is concerned with problems similar to those treated in the *Critique of Pure Reason*. The approach is somewhat different, but I assume that the direction of the main argument is now clear. I am starting with Kant's formula for possibility rather than ending with it, and I am using parameter, a new term in this field, in place of "intuition and concept", as the unit of possibility. The many uses of possibility in science, logic, philosophy, and common discourse ought to become intelligible as the argument progresses. At the end we should have exposed the outlines of a general methodology. I hope that the essay as a whole will serve the end of all methodology, the clarification of ideas.

CHAPTER I

INTELLECTUAL IMAGINATION

One of the most puzzling affinities in human thought is the free play of the imagination in harmony with the concepts of understanding. It is a commonplace that scientists as well as poets happen upon the clues to their discoveries in their day dreams. It is also to be noted that one of the most significant differences between minds is in the uses made of such imaginings. It seems that every great discoverer in the history of thought has had some private and persistent muse luring his sober reflections into more daring speculations than the ordinary run of mankind find safe and familiar, and genius has consisted in yielding to the temptation of metaphor and mythology. In this Aristotle is justified for having said that the command of metaphor is a sign of genius.

The point made in the essay by Walter De la Mare, mentioned in the Introduction, applied the principle to poets. It can be as well applied to scientists, but before I do so, some considerations apparently remote from scientific method are necessary.

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There are times when things haunt us with an otherworldly significance. They fascinate us in a mysterious way until we are driven in search of their meaning. We take flights of fancy and do not rest until we have caught the appropriate idea, as it were, on the wing. A phrase, a gesture, a tone of voice, a bar of music, the flower in the crannied wall, a skylark, or a Grecian urn sets off, we say, a train of association. A social situation puzzles us, and we worry until in a flash it becomes clear. Sometimes ideas seem to float in the air, hovering about—to our exasperation—and finally lighting on something which in consequence suddenly takes on meaning.

Certain theories of art speak of the unreality of the esthetic object. Some go as far as to found an entire explanation of the esthetic experience on *Schein*, *Spiel*. Art seduces by illusion. One enters a theatre with a willingness to be fooled and charmed by deceptive tricks. The play is spoiled if psychic distance is not preserved. There must be an inviolate atmosphere of make-believe as the medium for histrionic magic. One's critical powers must be kept in abeyance if he is to achieve the isolation and repose of the esthetic moment.

At the same time the presentation must be expressive. Its form must be instinct with significance. It must have depth as well as design. It must be a reservoir and channel

in service of the aesthetic idea. Music catches and expresses the Platonic idea.

The psychological theories of artistic creation point to corresponding features. Play and make-believe are fundamental human activities which, becoming socialized and communicative, express themselves in creation. Suppressed wishes find release in sublimation, imaginative compensation for a "real activity". Art is the saviour of man by solving his animal conflicts in the ideal realm of dream and illusion which is art. Tragedy renders even the spectators creative and through vicarious experience purifies their psyches.

In religious ritual the aesthetic undergoes an inversion. Here the worshipper is led from the unrealities of commonplace life and communes with the realities of the spiritual world. The elements are still aesthetic objects, but the interpretation is that they are vehicles of more genuine and essential significance. Pictures become icons, men become priests, and man is an immortal soul. The bell and the prayer are the occasion for the miracle of transubstantiation and the presence of divinity, before which sense and sin disappear; and the church becomes the communion of saints and the body of Christ. The holy is the real.

These rather perverse selections from literary psychology, aesthetic theory, and

the interpretation of religion are announcements of an important discovery for which there is evidence from many other sources. Primitive and modern man, speaking in diverse tongues, say that things are full of spirits. Mediævals were acquainted with angels. Early scientists decoded nature as if it were God's handwriting. Sensations have been divine signals and even animals are said to guide their destinies by faith in objective reference. Like Plato's theory of reminiscence, they are literary arguments for the real presence of an intellectual content in experience; or if they are not arguments, they are more or less eloquent exclamations on the occasion of what Mr Santayana has called the discovery of essence. For us it is the recognition of possibility. If these exclamations are not persuasive, a novel of Dostoevski might be more effective. At any rate I am assuming assent to some such proposition as this: I have a datum which, either by itself or in combination with other similar data, may serve as a symbol, that is, may be significantly asserted as true or false. It may not have propositional form, often is more like Mr Bradley's "wandering adjectives", or merely an isolated variable, but is the entrance to another world. I shall try to describe its nature.

There is a suggestion for such a description in the vicissitudes of the psychological

analyses of imagination. The first attempts were based on a classification of sense imagery, visual, auditory, tactile, kinesthetic, and so forth. It was fashionable for some time to speak [redacted] visual or auditory types of mind. Galton's studies were based on this. Closer examination showed that sense departments had strong tendencies to blend and that the outstanding mental types showed only predominance or vicarious functioning of one for another department. Some subjects claimed no images at all. Then there was an investigation of imageless thought and behaviour patterns. Recent experiments on learning have led to the theory that relations are apprehended and abstracted, and that they function in imagination as forms.

From this it seems that psychology is making an empirical distinction between what used to be called form and content, and their investigations show that the distinction is still good, though it must be contended that it is a subject for logical rather than psychological analysis. We may say, then, that imagination has content and form. The former I call concrete imagination, and the latter intellectual imagination. Further, it is by virtue of the latter that the elements of imagination become symbols and are significantly assertible as true or false. The logical analysis of imagination that would show this is very difficult to make.

Some art critics attempt it and fail for lack of an adequate logical subtlety. I shall not enter the lists with them except to illustrate the distinction I am making.

One instance is common and easy enough to analyse to introduce here, that is the logic involved in so-called free association. One writer has called this abductive reasoning. We day-dream: one thing reminds us of another, and that of another, until we have travelled far away and reached the most surprising "conclusions". The "argument" rests on a chain of analogies, each link of which is different from any other. A great deal of our everyday cogitation follows this form, a great deal more than we realize. Arguments about politics, or the behaviour of our neighbours and acquaintances, justification of our own attitudes, and advertising copy exhibit the pattern. Historians and anthropologists make very skilful use of it; in those subjects it goes by the name of "mutually supporting hypotheses". Perhaps the best use of it is in anecdotal conversation, or in essays like Lamb's *Roast Pig*, where aesthetic form is more important than intellectual rigour. Its use in newspaper editorials and in forensic discourse is not so agreeable, since it is quite effective. A recent writer has pointed out its application in psychoanalysis. He proposes a new name for that science, psychomalogy.

However, imagination is too versatile and whimsical for the critical logician. If we are to disentangle the intellectual from the concrete, we must turn to some permanent product of fancy. The various forms of literature are our best specimens and most of the points are obvious before we make them. Yet we must be careful not to confuse our analysis with literary criticism proper. Imaginative form is not artistic form. There may be a difference of one without a corresponding difference of the other. A novel may be identical with an epic in imaginative form, or intellectual content, though obviously different in artistic form, just as one proposition may have different notational expressions. Likewise one artistic form may be used for different intellectual contents. With a perfect language this might not be the case, but perfection in language in that sense does not seem imminent.

Perhaps this is the place to state my position on the issues of notations, languages, imagery, and so forth, and their relation to logical form. I am assuming that linguistic elements, as they are called, taken materially, are related to logical or intellectual forms as values are related to variables. They hold a status like any particular which may satisfy a propositional form. If such forms are universals, then words, gestures, notations, images, which may have aesthetic or natural

characteristics as well, in so far as they are adequate expressions of intellectual form, are instances of them. In other words the relation is logical, not naturalistic.

The novel of the last century affords a good example of works of literature containing very elaborate imaginative forms. Abstracting from their strictly aesthetic features, one has left vast conceptual structures which may be analysed and codified. These systems are not the structure of the novel referred to in literary criticism, but rather approach the character of scientific hypotheses. The characters from this point of view are not objects of concrete imagination, but elements in a structure which is applicable like scientific theories to many actual situations. For instance, take Thomas Hardy's *Return of the Native* or Flaubert's *Madam Bovary*. Egdon Heath and the French village are elaborate naturalistic backgrounds upon which persons and events appear by a kind of projective geometry. Events appear there in concatenations and these constitute an abstract causal order in a deterministic world. It is probably because of this naturalistic determinism, which popular science has made familiar to us, that these novels are called realistic. If it is asked whether they are true to life, the answer hinges on the degree of abstraction one has achieved in his analysis. If the characters

appear concrete by reason of the magic of words or familiar association, they are " true to life ". If the intellectual form is stressed, they appear extremely romantic, unless by chance the whole system applies directly in one's own experience, and he identifies himself with one of the characters. However one may judge them, the particular point that seems significant is that they spread a vast canvas of possibility on which actual affairs may be projected and seen in perspective. It is this world of new perspective that has the unreal character and gives us the illusion that art is supposed to have.

From the novel we can make journeys in possibility in any direction, toward religious cosmogony by way of proverb, myth, lyric, or drama, or toward history by way of pageant, legend, saga, or epic. The scale here is from tentative fragmentary ideas to complete and detailed elaboration. Another direction would give us our science.

It seems to be an historical phenomenon of considerable frequency that any of these forms of imagination is transformed into another by what would be called in algebra " expansion ", that is a combination of several operations, notably equation and substitution, in short, transformation by formula. An old ritual gets a new interpretation, an old wives' tale finds new

application, an epic becomes sacred Scripture, and by cross breeding with other systems has numerous progeny. Jane Harrison's account of the development of ancient myths and rituals into the Greek drama is a case in point. The persistence and universality of certain myths seems to indicate not only the pleasure in retelling and rehearing a story, but the presence of an intellectual form which has found frequent application in human experience.

A large part of history and social science may thus be subsumed under literary imagination. The frequent restatement and the persistence of certain theories of human nature, approximating those of Hobbes and Locke, is a case of this. Man in a state of nature occurs in early Greek writings, is formulated in theoretical terms in Plato's *Republic*, and follows the course of poetic, fictional, and sociological writings down to our own time. Usually this Golden Age of the writer's imagination is placed in prehistoric times; history shows a decline from such freedom and the original state remains a standard of measurement for each event. But its imaginative character is revealed when we find it expressed as the hope of the future, or even in terms of large social programmes, blue prints for the millenium. Such utopias serve as system functions for a variety of sub-systems. Their

use is discerned even in history writing which is often the portrayal of an inverted utopia, where hopes for the future get confused with long lost precious things. When compared with archeological data or a new archeology, it has to be revised to keep its hold on our imaginations, to say nothing of our beliefs. The sense of reality is only more firmly demanded in history than in social science, in social science more than in fiction, and in fiction more than in fairy stories. The difference between them is one of degree rather than of kind

Barring modern science, I suppose the grandest of all these examples of intellectual imagination is to be found in Dante's *Divine Comedy* and it is a very instructive instance. Here in one systematic presentation is a rather complete integration of several great cultures with all their disparate and conflicting possibilities By discrimination and elimination of concrete imagery we can uncover one form after another, through personalities and gossip to political theory, philosophy, and theology, each including in itself those that have previously been discerned. Medieval thinkers seem to have had extraordinary ability in the critical discrimination and use of such multiformed symbols. It is said that dangerous, but vital, political issues were for various reasons discussed in terms of Latin grammar. Dante saw the distinctions, but

at the same time held them together by forms of imaginative thought which are quite comparable with the refined mathematical functions by which we handle the networks of physical science. Dante was a supreme master of metaphor.

One of the most exciting chapters in the history of scientific thought will some day be written on the subject of Dante's relation to the rise of modern science. It has a parallel in the history of Greek culture when Homer, the dramatists, and the historians refined the field of possibilities and laid the intellectual foundation for the scientific and philosophical developments under Democritus and in the Academy and Lyceum. I have called this the algebraic expansion of an imaginative formula. Likewise, Abelard, St. Thomas, and Dante worked over the Neo-Platonic and Aristotelian formulæ, enriched them with varied lore from myth, magic, and religion, and expressed the results in their full elaborateness and integral form. They were reservoirs of ideas, clues for the curiosity of the observer to track down in the laboratory and through the telescope. We are accustomed to the story of the revolution of science against authority. Another story can be told of the extension of the rationalism of theology into the field of nature and its revision and reformulation in contemporary science. This ignores some of the heroics

of nineteenth century historical melodrama, but has the advantage of taking account of some significant facts and theories which that, for some reason, chose to omit.

One of the puzzling phenomena in the development of thought is the continual supercession of new theory over old. We wonder what the validity of the new can be if by age it becomes invalid. The answer seems to be that it does not become invalid. It is true that intellectual form is continually in danger of being degraded to mere concrete imagination or lore. The word takes the place of the idea and criticism is required to save it from decay or fossilization. But it is the function of history to keep it revised and in a form that is available for use in the passing intellectual process. The wisdom of the ages is the conservation of possibility.

So far I have been indulging in impressionism. The points I have made are suggestive rather than analytical, but I may be forgiven if it is recalled that the subject matter approaches that for which Aristotle said there was no science. We cannot lay down rules for imagination, not even for the intellectual imagination. However, we may keep account of the cases we note and draw tentative conclusions.

Possibility has been identified in the intellectual form of imagination. I have pointed out the discovery of such intellectual

form in various kinds of imaginative activity. It is by virtue of this form that imagination has its symbolic function. A given symbol has two references, to other symbols and to a somewhat that seems to lie outside of discourse.

First, it leads to other symbols, in the simplest case by analogy or the discernment of similarities. It is this that makes elaboration and extension of meanings feasible. We thus have systems of ideas of all degrees of complexity. These are capable of logistic formulation and literary expression. These logistic and literary devices are the magic bridges by which we lose ourselves in the world of imagination. Such mystic ways are often provided explicitly in the prologue to literary works. Virgil and Dante take us to the Avernian caves and by wearisome and dangerous paths lead us to the underworld. Jacob slept in the valley of Bethel and dreamed of the descent of heavenly visitors. Jules Verne and Mr. Wells take journeys in projectiles and time machines. Plato gives our souls wings. The modern novelist has one of his characters tell him the story, or introduces the reader himself as spectator. The historian gives us a place and date. In conversation or solitary meditation "something reminds us". For the mathematician "if" has all the potency of a prologue. It only needs to be followed by the postulates

of the possible world that its Muse suggests and he is a charmed wanderer in an enchanted possibility. Thus we go over to the " floating idea ", and as if on Gonnilo's perfect island, we climb its valleys, storm and defend its castles and keep company with its fairy inhabitants.

But there are sometimes Cinderella endings to our journeys. Actual discourse and imagination are seldom as systematic as their subject matter demands. Logic tells us how we ought to think, not how we do think. Æsthetic form contaminates intellectual form and when that happens the charm is broken. Language, imagery, intent, are irrelevant [redacted] their leadings and we get the impression that possibility is fragmentary and whimsical. It may be so. It may be that ambiguity never lets us get more than a fragment of the world we enter clearly focussed and single in intent. Yet it is one of the most human ambitions to clarify and understand, and we believe in what we seek,—clear and distinct ideas.

In trying to realise this ideal, we find that possibility has another reference. I have said that intellectual form is a symbol which may be true or false. As imagination possibility is to be understood and enjoyed, but the urge for clarity drives us to apply it and test [redacted] out. Pure imaginative possibility

has responsibilities and when it submits to them it becomes scientific possibility. Its own survival depends upon it. "If . . . then" has a very austere and familiar sound. We move on from make-believe to discovery.

CHAPTER II

SCIENTIFIC POSSIBILITY

When imaginative or esthetic possibility takes on responsibility, it becomes scientific possibility. The responsibility looks in two directions, systematic order and application. These are the results of discipline. Scientific imagination is disciplined imagination. This does not mean that imaginative possibility is without form or order. It has a rigour and discipline of its own proper kind, but it need not be intellectually rigorous. It has poetic licence. It is our rather difficult task to point out significant features in the transition. Pegasus may become the scientist's plowhorse, put on a harness and turn up the soil for the planting of crops, physical, biological, and anthropological, but he is still a spirited horse. One who would account for his every move is bound to be embarrassed since his most powerful tugs at the plow are preceded and followed by many a playful pose. He has never been completely domesticated and broken. One who would get close to him should be cautious, but not timid. He will need both philosophic caution and a licence to use terms in new ways in

treating such a field as scientific method. The old terms have broken down quite recently, and there is something almost hysterical in the present discussion of the subject. The new terms should not be permanent additions to the subject matter; they should be catalytic rather than constitutive, clarifying and precipitating the significant ideas from this, still the newest and most puzzling component of our culture. Induction, hypothesis, deduction, verification, prediction, and so forth are the old terms. I shall try to analyze, clarify, and reinterpret these as various applications and uses of the concept of possibility.

In the history of science many fashions in terminology have come and gone. These fashions are in a certain accord with the particular stage of scientific development contemporary with them. The one most harmonious with the present state of science is mathematical logic. In its terms scientific hypothesis is a propositional function which by itself is neither true nor false. The reason for this is that it is a formula containing variables, and only by substitution of the proper values does it become a proposition which is true. Sometimes it is said that the propositional function states a relation between terms which represent classes. The class may be thought of as the extensional field of variation of the term. Whether

this or some other symbolism is correct or preferable or not, I cannot say. This is a practical or aesthetic problem for the inventor of logistic devices and the refiner of technical languages, which are necessary in the advancement of any specialized branch of scientific study or art. These devices and languages are the instruments of science qua art. Further, it seems that for any given universe of discourse there is an indefinite number of such languages and notations. The choice of them is a matter for pragmatic test and should be left to the specialized technicians in the field. In so far as we have a specialized field, it is proper for us to make such a choice. I shall try to do this, making as few changes in current logical terminology as possible.

Suppose we take a simple assertorical proposition typically expressive of what we have called imaginative possibility: gold glitters. If this is changed to its hypothetical form, it becomes by the introduction of a variable; if *x* is gold, *x* glitters. This is a scientific possibility in its simplest form. It can be seen that the hypothetical form is neither true nor false unless we apply it to a special case of, say, a gold nugget. In other words, "gold" and "glitters" are variables as well as *x*, and it is precisely this that gives them their hypothetical aspect, their status as possibilities.

On the other hand, these variables have

limited scopes which are determined by what has often been called "common properties". The terminology I wish to introduce is taken from mathematics. Suppose we call "gold", "glitters", and x parameters. All possible gold things will be in the field of variability for "gold"; similarly all possible glittering things will be the field of variability for "glitters"; x-ness will have all possible x things for its field. The common properties we shall call identity conditions. A parameter will then involve an identity condition and a field of variability. If a hypothesis is now stated in terms of parameters, we shall find at least one parameter whose field will contain the fields of the other parameters, and at the same time will determine the relations of these fields to one another. For instance, if x is gold, x glitters, means that there is a parameter x, such that, within its field, "gold" is contained in "glitters". More complicated hypotheses involve more parameters and the relations within the field may be correspondingly complicated

One can see in this the beginning of a system which would result from the fixing of these parameters with relation to one another, and further, their relation to other parameters which may be invented or discovered. One can say that the special work of science as distinguished from artistic work is the definition of the identity conditions for

parameters, so that there will rise a parametric order or hierarchy. Such a hierarchical concatenation of parameters will be a system.

The term, parameter, etymologically and literally, means a "measure with respect to". Its present usage in mathematics and the generalization of it which I wish to make in this essay can best be clarified by further illustrations.

The normal use of parameters in mathematics is rather narrow, as when it is applied to complex functions of many variables. Its narrow use is, however, derived from a more general use, which is best exemplified in geometry when figures are given genetic definition, as in the definition of line as the path of a moving point, or a circle as the plane figure developed by the rotation of a line segment of given length having one end point fixed, or a sphere as the surface developed by the revolution of a semi-circle about its diameter. In these formulæ one can discriminate (1) what I shall call an identity condition or constant, (2) a class of particulars ("path," "plane figure," "surface") often called *loci*, but here called the field of variability, and (3) a rule of order, or set of relations ("moving," "developed") which holds between the particular determinations or members of the class. These are the three phases of any parameter, or we may say a parameter has an identity condition,

a field of variability, and a rule of order. The notion thus generalized covers all the conceptions involved in geometry. One very interesting application is in projective geometry where a figure (identity condition) retains its identity throughout a series of transformations according to rules and takes on various particular determinations as a consequence (field of variability). Such transformations can be carried out as long as the rule is not violated and each particular determination has definite relations with every other.

It seems that the verbal usage in algebra would be improved if the notion of parameters were more generally introduced. It would clear up the ambiguity of such terms as variable and invariant or constant. As it is now, a given symbol in an equation is called both variable and invariant, and this leads to such apparent contradictions as constant variable, and variable constant. When variables are identified with or explicitly recognised as referring to parameters, the contradiction is resolved by a relativity inherent in the notion. In $x + y - 6$, x and y are variables in that they refer to a variety of values which will satisfy the equation, but they are none the less constant, since the range of values which will satisfy the equation is determined and limited. For instance, an imaginary number cannot

be legitimately substituted for x or y. This range of values can be said to be determined by the identity condition of x which must remain constant with respect to the relations ■ holds in the equation, or we may say that its range of variation determines what relations it may hold in the equation. Both of them must be determinate if the equation is to be significant.

This relativity can be further illustrated if we suppose $x + y = 6$, now symbolized as $f(x, y)$, to be substituted for a variable, say u, in some higher function, say $F(u, w)$, which would then read $F[f(x, y), w]$. Here f and F represent constants, but f is of lower order than F and may vary under the conditions fixed by F, as x and y vary under conditions fixed by f. In this connexion f and F may be said to be of different order. However, together and with other parameters, they constitute what I shall call parametric order. In such an order all symbols represent parameters which are relatively constant and variable according to rules.

The correlation of algebraic formulæ and geometric figures which is the subject ■ analytic geometry is made possible by the recognition of the notions involved in parametric form. For instance, $x^2 + y^2 = r^2$, or the more general form $ax^2 + hxy + by^2 + 2gx + 2fy = c$ symbolizes through its system of constants and variables, its parameters,

the *locus* of a circle on a Cartesian system of axes. The form of the equation and the form of the curve are identity conditions, constants with fields of variability whose particular determinations are numbers or points indifferently.

We may now say what might have seemed rash before, that parameters are mathematical functions in their complete structural detail where every function is a function of a function. More strictly speaking mathematical functions are one of many alternative notational devices for exhibiting parametric order. Other notational devices are allowable and are actually exemplified in other universes of discourse.

Their presence can be detected by distinctions analogous to those we have made in mathematics. Lines and figures are said to have properties, likewise equations and series in algebra. Physics and chemistry use similar language. Fields of force and chemical elements have properties; they used to be called potencies. In mathematics we mean that lines and figures retain an identity throughout certain regular transformations. In physical science we mean that physical entities retain certain recognizable characters throughout certain controlled processes. These fulfill the requirements of our definition of parameters. A property is a parameter, or a notational device for exhibiting a para-

meter. More complicated cases occur when we speak of the laws or principles of a science. Here we have the analogue and further extension of Cartesian geometry. Axes of reference are chosen, say two mutually perpendicular lines, and a curve is determined by a series of measurements from each axis in terms of some unit of length. These points are connected by a smooth curve, and the appropriate equation is written in terms of "unknowns" which vary in certain relations which are expressed in the form of the equation. The relations are constant while the variables take on values which satisfy them. So observations are made in the laboratory with reference to certain units which are assumed to apply to selected features of the material. The results of such observation in the form of measurements or states of the material are tabulated and arranged in some order and are thereafter conceived as cases of a generalization which is said to be the law, or principle, of the phenomena which obey it. The law "holds" for the various instances as the smooth curve passes through the points of the graph. It is a parameter with an identity condition and a field of variation within which values are related according to a rule.

A less technical type of illustration is dangerous, yet is feasible if interpreted with care. Suppose we perform the schoolroom

experiment with the steel bar magnet and iron filings. A piece of paper is laid over the magnet and iron filings are sprinkled over it. A gentle vibration of the paper will allow the filings to arrange themselves in a pattern which exhibits the lines of magnetic force in the field of the magnet. The ideas expressed by the terms I have used are related in a hierarchy of the parametric character, and find their geometric interpretation in the figures made by the filings. "Lines of force" in the "field" of the "magnet" form a "pattern". The order can be symbolized as follows:

Magnetic influence = $F\{f[\phi(a, b, c, d, \ldots \text{etc.})]\}$ where F is magnet, f is field, ϕ is lines of force, and a, b, c, d, . . . etc. are particles of iron.

Or, suppose we have a gas engine with cam shaft, cams, and valves. At intervals on the cam shaft there are discs of irregular shape such that, on each revolution of the shaft, a notch or indentation on each of the discs comes opposite a cam which drops into it, and thus operates the valve of a cylinder. A machinist's blue print would exhibit these features. Here we have a fairly elaborate complification of certain ideas that the inventor probably had, and that we must have if we are to understand the gas engine. These ideas would be about a revolving shaft, indented discs, cams, and valves, each of which holds relations

to every other so that there is motion under constant conditions in time and space, such that each revolution of the shaft would exemplify or fulfill the basic condition that valves are opened and closed at intervals synchronous with the desired positions of the pistons. These ideas are subordinated and related in parametric order. Here variation under conditions and according to a rule is exemplified in motions fulfilling set conditions.

Still another: An automatic lathe is so built that by putting in a pattern which acts on cutters like the discs on the cam shaft act on the cams and valves; and by putting a piece of rough wood or metal into clamps on a revolving shaft in proximity to the cutters; and by making certain adjustments of the levers connecting the pattern and the cutters: a most intricate and complicated product is cut out of the wood or metal. Here again the revolutions of the shaft and the operation of the levers by the pattern exemplify a set of ideas which are related as parameters in correlation and subordination. The blueprint would geometrize the action and the formula would express it algebraically. In the same way mechanical, chemical, electrical, and vital phenomena can be measured and described in terms of conceptual systems of the parametric character.

The most obvious illustrations are of course the instruments of precise measurement used in the laboratory. All these, from the foot rule to the telescope, are attempts to materialize parameters. To the extent that they are accurate they achieve this. Certain features of them are made to remain fixed and constant; other features are adjustable; they correlate readings on dials or crosswires or whatnot and thus exhibit the relations that are sought in measurement. A rather complete account of scientific development could be given in terms of yardsticks, calipers, balances, thermometers, magnets, pressure gauges, microscopes, telescopes, lenses, prisms, and many other standardized material objects, including, as a happy thought of Protagoras and the pragmatists, the human body.

It can be seen from all this that the term, parameter, has another appropriate connotation. It is a measure by which we refer diverse data to a standard. This reference is what Kant would call the synthesis of a manifold, but I am not dealing with the epistemological aspects of the matter. Instead I am pointing out what might be called the necessary conditions of measurement which require that the material of experience have features which are distinguishable and capable of representation as values of variables, or arguments of functions, which occur in

discourse. For instance, when I use the term horse, I may assume that there is a pattern of features distinguishable in cases of observation of real horses, whatever we mean by "real", and that this pattern of features is a representation which may serve as a value in any proposition which I may make about horses. This instance is as relevant as the apparently more rigorous use of the foot-rule or yardstick for measuring distances, where feet and inches constitute patterns of features in observable things and serve as values in propositions of applied geometry. Just what is ultimately involved in any such postulate as this would be hard to say. I have attempted to state in greater detail the methodological aspects of it in a later section of the essay.

A still further extension of the term is a matter of faith in intelligibility, yet it has some justification. It can be assumed that some fossilised ideas in the history of thought are ghosts of parameters. The notions of potencies, faculties, angels, demons, and spirits, or their derivatives, survive in our common sense discourse, and it is not surprising to find that they symbolise a core of clear intellectual content. This core on analysis exhibits a structural form of the parametric sort and once served the function of measurement as rigorously as our contemporary analytic language does. In fact,

they are more rigorous and incisive than many of our social scientific terms. For students interested in the history of their subjects, the introduction of the parametric critique might be very illuminating.

It is only a slight jump from this, a jump which is easily justified, to the recognition of ideals of conduct, standards of criticism, and the norms of social and political thought as instances of parametric order. But in this and the preceding paragraph we have entered a field where caution must be emphasized. The need of such emphasis is an excuse for sounding a general note of warning.

Parameters, as they occur, seldom achieve definition. It is only on those rare occasions when the scientist becomes his own critic that we get an authentic report from him about the intellectual tools of his measurements. When terms have become imbedded in ordinary discourse, it is a respectably mature philosopher's job to open the critical eye and clarify the vague and ambiguous symbols of conversation, or the habitual phrases of a technical jargon. One might add that it is almost always a thankless job to do it, and even at times dangerous. On this account the three characteristic phases I have marked in parameters are seldom exhibited fully in any notation or analytic language. They have, as it were,

nicknames by which their familiars know them. A stranger needs an introduction, and then must do some detective work to get the pertinent features focussed out. This is the particular function of a critical philosophy, or that branch of it which is known as dialectic. It is a dangerous pursuit for young men, as Plato said.

Logistic studies are interesting in this connexion. Dialectic as the verbal manipulation of parameters, has a great deal to learn from the newer developments in these studies, as Mr Mortimer J Adler has shown in his work on this subject. It seems that algebraic notations are preferable to words in that they compel one to find out the meanings of his terms before he uses them. They force one to discover and eliminate the vagueness and ambiguity in verbal discourse, and make it possible for one who cares to do so to find out what he is talking about. One of the best products of science has been the development of technical languages. These are important not only for communication but also for greater clarity of thought. Their value for critical thought is even greater than for social understanding. They are also important for the scientist. Logistic systems have been worked out and are at hand. Their use might save the scientist many of his inaccuracies and ambiguities. When such logistic systems improve in

efficiency they exhibit more and more fully the features of parametric form. They are calculuses of possibility.

The varieties and elaborations of these calculuses of possibilities are unlimited as far as we know. But whether it be in terms of propositions, relations, and classes, or whatnot, the elementary forms of the system developed will involve the orders of constants and variables that we have named parameters. The central principle is variability limited and controlled by identity conditions. In an older tradition such identity conditions have been called conditions of possibility. They were principles of synthesis for a manifold or multiplicity of particulars.

At frequent stages in the history of science certain parameters have been taken as basic, that is, more fundamental in the ordering of thought, and these basic parameters have been called necessary concepts or categories. This interest in finding basic concepts is natural enough. Just as arithmetic by its universal acceptance is extremely useful in practical affairs, so a universally accepted calculus of possibilities would enormously simplify our plans and social intercourse. However, no such solution of the world's problems has stood for any considerable length of time after a new and more simple or more inclusive system has been invented and offered for use.

Along with this interest has gone another of similar intent, namely, to draw up a criterion by which one system can be compared with another for purposes of selection and elimination. Thus the famous principle of simplicity, called Occam's Razor, represents such an attempt. Let not hypotheses be multiplied beyond the point of necessity to explain the facts. This rule was enunciated on the basis of a dogma that Nature always takes the simplest means to perform her purposes; in that content it has one implication, namely, that an unnecessarily complicated hypothesis has low probability of corresponding with Nature's doings. It has been taken by students of methodology as a canon of science and for those who have accepted some systematic view already, and become familiar with it, it has a comfortable meaning. But when it is appealed to as a criterion of preference for one system or another, it is emptied of any unambiguous content. The question regarding just what parameters are needed in the development of a system is always pertinent, but it cannot be solved by any appeal to arithmetical count or minimum number of elements, comparative or absolute. Whether a given parameter is needed is to be determined by detailed examination of relations of implication and not by any arbitrary external standard. Simplicity ■

an absolute criterion only for a simple mind.

There are, however, criteria which are often overlooked, but whenever pointed out, are admitted. These criteria are the laws of thought, so-called. They really amount to a formulation of the rules for valid inference in general, and their particular application in science is only a specific case of this.

The laws of thought have many interpretations, usually distinguished by the use to which they are put. Fortunately, for our purposes they can be made fairly clear.

In terms of our account of systems, the law of identity simply means that which is implied in the name given the parameters, identity conditions. It means that the limits of variation fixed by the parameter shall remain the same in whatever relations it is involved. The law of contradiction exhibits this condition further. It means that in case of conflict between two or more parameters in the system, such that one or the other must change its identity, either a redetermination of parameters must be made by definition or the system must be condemned as useless. The third law of thought means that any parameter introduced into the system must have its range of variability so fixed that it will not become ambiguous in its applications.

Another characteristic of parameters is important if we are to understand their applications. The identity condition which fixes the order of the parameter is usually defined in terms of other parameters of higher order. With respect to the field of a given higher parameter, its identity condition becomes a relation generating a rule of order or pattern of variation, usually of serial nature. It is through this relation and pattern that the parameter determines a field of variability in which lower parameters occur. For instance, in mathematics the combination of certain parameters such as "betweenness" and "points" will originate and develop an infinite series. "Gold" in chemistry will determine a configuration of properties, etc.

This characteristic has many functions, most important of which are the grounds it lays for the important processes of induction and deduction.

Induction and deduction, in so far as it is a matter for logic to handle, are concerned with the determination of parameters. It is their function to trace implications by the process known as inference. If we can show how parameters are determined, a general theory of implication and consequently rules of inference may be derived from it. Here again we would find ourselves in a very difficult field if we did not insist on the

particular formulation that arises from our terminology.

As we have said, a parameter is defined by an identity condition which determines the field of its variability and at the same time an order or configuration of variation. Any parameter is then a constant for its field of variation and a value in the field of variation of a parameter of higher order. Further, a parameter of lower order may be substituted for a variable in the field of any given parameter, and this may again be substituted for the variable in the field of the next higher order. We may then speak of any parameter x and its sub-parameters x_1, x_2, x_3, . . . x_n and its super-parameter X. This terminology may be used for categories or theories of types and for our purposes is adequate.

It will be noted that the rule of order for a parameter X, will give a rule for substitution stating what may and what may not be substituted for x, y, etc., and similarly the identity conditions imposed on x, y, etc., will give a rule for legitimate substitutions for x_1, x_2, x_3, . . . etc. Deductive inference then is the discovery of sub-parameters and inductive inference the discovery of super-parameters for any given parameter. (If one would like to use the term "create" for "discover", there is no objection; we are not talking metaphysics.) The systematic

principle that serves as the basis for implication is then the law of substitution. It brings the parameters into a system; it gives order to the possible realm.

There are a few very pretty examples of systems having this parametric order. Take Mendeleeff's table of chemical elements. The notion of an element is one of those figments of possibility that goes back in man's thought as far as history carries us. This is taken as a sort of king parameter. It has a large range of variability and an elegant configuration within it. This configuration is developed by reference to another parameter called atomic weight. The field of this parameter is again referred to other parameters called properties, which are correlated with particular atomic weights (values substituted for the variables). By references to this table and the inferences drawn from the parameters, which have been verified by finding observable values for them, to others that were merely imagined, discoveries of new elements have been made.

Imagination has been harnessed in this field and the crops are now being harvested and new ones planted. Such scientific possibilities as the Mendeleeff chart symbolizes become not only chart for new research, but also a sort of permanent blue print for industrial manufacture and programmes of sanitation and the like.

The determination of a new parameter is heralded as a scientific discovery. Pegasus has learned a new trick and the plowing goes on.

At this point the practical scientist and probably the scientific methodologist will object. Science is not mainly concerned with possibility, he will say, if possibility is equated with man's imaginative creations, or with the discovery of Platonic essences. This objection is well taken if it means that this is not all of science. We may even go further and say that we have not said all we intend to about scientific possibility. All we have handled so far is what might be called intensional scientific possibility, that aspect of ■ which is most amenable to logistic manipulation. There is another aspect which we shall call extensional possibility. This corresponds pretty closely, as we shall handle it, with what the scientist means by scientific reality. This is undoubtedly what we have omitted. What then is scientific reality from our point ■ view?

There seem to be two classes of such facts, the observable and the inferred. Observability is often referred to as the criterion of a fact, but in practice it is seldom fulfilled. If we are treating science as ■ is done, we must not take observation as our only criterion, for if we did we should exclude

a large number of the facts ordinarily claimed by science.

From our point of view a scientific fact is a parameter taken in extension, that is as a particular entity or substance. It is clothing a bare possibility with the warm garment of actual existence—and is sometimes justified in artists—but the existence so conferred on scientific entities is somewhat of a disguise. Intensional possibility is rather like a mirror reflecting actuality, more or less faithfully, with a minimum of distortion. A certain type of scientific mind is tempted like Alice to walk through the looking-glass and explore. He comes back and tells us of a truly wonderful world of space-time with objects most unbelievably perfect and unchanging. Even the most sophisticated scientist takes such journeys at times, with Lewis Carroll, though usually disclaiming any serious interest in such necromancy and warning others not to take it seriously.

It would be a great service to our general culture if some modern Lucretius would sit at the feet of an Einstein or a Bohr until, his soul taking wings, he should be inspired to make the research magnificent and write it down in rhythmic lines. This would be better than "outlines of science" and might well be esteemed comparable in value to our newest symbolic systems. On the chance

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that some aspiring young poet find this essay, let us make a few suggestions to him.

The first stop in the Realm of Being would be the fairies' ballroom. The floor is a frictionless plane, a mosaic made of perfectly dimensionless cobbles called mathematical points and the girders are perfectly straight lines, infinite in number and running in [redacted] directions. Strange to say the ballroom never ends in any direction and its walls, like the floor, are planes movable in any direction and to any distance. Our poet might find out whether or not the floor and girders are really warped and curved like rays of light.

The ballroom is rather crowded but everyone seems to have enough room except in concentrated vortices that are due to a certain attraction the dancers have for one another. Whether the attraction is a force or just the effect of living in a curved space we don't know. That, too, might be investigated. The dances are most interesting and variegated in pattern. Most of them seem to be like Aristotle's spheres, circular motions; only the very powerful unmoved mover, the Nucleus as he is called, is in the centre and lone circle round him at terrific speed. Some of these are very large groups and some small and the dances go on unchanged for a century or so. These groups combine into the molecular groups which

have most complicated structures which vibrate and are apt to combine with other molecules and build up most elaborate though unstable choreographies. All this dance takes place in a perfectly frictionless fluid, perfectly elastic ether, which undulates and adds zest to the dance. The music for all this is written in mathematical notation and is played and sung by the dancers. No one knows when the dance began or if it is ever going to stop. The costumes are not very interesting, though the lines are good, mostly geometric in pattern.

The reporter poet might then go to another realm of being and find a kaleidoscopic world of crystals, apparently created by Plato's demiurge on the model of geometric figures. Here everything can be triangulated and it appears that all the possible permutations and combinations of triangles are exemplified. By a sort of temporal projective geometry these crystal formations make up the development of geological strata through the centuries. This is a sort of stage scenery for other bodies not crystal in form but apparently amorphous from the geometric point of view. These cosmic characters live in a sort of semi-fluid slime and slowly one gets a vision of a world of life, a most mysterious realm. The creatures of this world move by an inward urge, they grow, give birth to others, and die. These new

things grow, give birth to still others, and die. They follow typical forms, but then there are divergencies and a new type arises until there are presented an immeasurable number of genera and species with a common bond joining them in a community of animate nature within which certain laws of heredity seem to govern activity and change.

Finally, our poet goes to a greater distance and finds that he has another ballroom of giants: planets and comets, moving about their suns and the whole drifting like Lucretius's atoms in space. This is a replica of the fairy ballroom, except that there seems to be no fixed direction and no floor. Here we talk about spheres and cones that form a sort of glorified cosmic amusement park—for gods and demons

These and many other things such as the entities in social science—native instincts, conditioned reflexes, habits, dispositions, social habits or customs, group minds, sovereignties, etc.—are worthy of a modern epic. These are the stuff of our culture and civilization as much as angels in heaven and demons in hell were the stuff of medieval life; or satyrs, nymphs, demigods and gods were the Olympian stage on which the Greeks played out the drama of their lives.

The methodologists of science are diffident about claiming this world. It smacks too much of mythology. We have explicitly

included it because no matter how cautious the practising scientist is, his readers and the man in the street are going to take him literally. It is better, it seems, to admit this world as given in the system and then interpret the system in such a way as to gain a perspective on, not only this, but all mythology. Pegasus, although he is harnessed, is still a live horse and plows a better furrow for having had gambol in the pasture, free from his logical shackles.

Further, there is a persistent attempt to credit this world with actual reality. There is no objection to the use of the terms as long as the distinction is not lost between this sort of reality and other realities. Perhaps it would be well to accept James's notion of a pluralistic universe in this way—there is a physicist's reality, a biologist's reality, a psychologist's reality, and presumably an historian's and a poet's reality. However, such a pluralistic universe is itself a possibility which has the characteristic of being a system of hypotheses taken both intensionally and extensionally. Reality is then a special term meaning the extensional interpretation of a system of postulates of postulational order. What is denoted by such a system is real, what is not so denoted, is unreal. For scientific thought, then, scientific entities are real in this sense. Whether any greater degree of ontological reality may be given to these entities is a

question that will very seriously concern us later.

We have purposely omitted any reference to the criterion of observability, not because it has no connexion with science, but because it is irrelevant at this point. Certainly, the hypothetical entities that we have reviewed are not observed, nor observable by themselves. Current epistemology is concerned with this problem. It insists that knowledge of reality—the scientists' reality—is never immediate. It is mediated by sense, essences, data, etc., which are not real existents. There is a leap from the immediate given in observation to the not given. These scientific realities are causes or necessary conditions of our experience, like Mill's famous "permanent possibilities of sensation".

Scientific objects hold a position in relation to modern thought very similar to the position of theological objects in relation to medieval thought. The schoolmen and their immediate followers, being pressed for the reasons of their faith, had recourse to the ontological proof for God's existence. Similarly, epistemologists who accept scientific knowledge as equivalent to genuine knowledge have recourse to a theory of objective reference which follows closely the older argument.

The predicament may be put as follows:

The first statement of the ontological argument is commonly attributed to Saint Anselm. It is usually quoted as follows: I have an idea of a Being than which no greater can be conceived; the idea is such that it implies the existence of the Being. This special argument was accepted as proof of God's existence. As such it was criticized by Gaunilon and others. It seems that their criticism brought to light its general or formal characteristics. The general formulation ran as follows: I have an idea such that it implies the existence of a corresponding object. Modern terminology would make the whole expression a propositional function with "an idea such that" playing the part of variable. Substitution of the proper value for the variable would make the expression a true proposition. On this basis we may say that Saint Anselm substituted "an idea of a being than which no greater can be conceived" and found it a valid proof for the existence of God. Gaunilon opposed him and to make his point clear substituted "an idea of a perfect island"; his experience led him to doubt the truth of the resulting proposition.

This opened the way for Hume and Kant, who made a further analysis. In modern terminology again, their version would read as follows: If *A* is a given idea, and *B* is an existent distinct from, but corresponding

to, *A*, then there is some relation *R* such that if I have *A*, I can infer *B*. Here the nature of *R* becomes the crucial problem. Hume treats it as he does causation. Any relation satisfying the formula would involve necessary connexion. There being no such connexion evident, existents must be contingent with respect to their ideas.

Kant showed that not only Saint Anselm's, but also the other two, famous proofs of the existence of God were special cases of the ontological argument. By the substitution of the relation of causality for *R* the cosmological proof results; by a similar substitution of some teleological relation one gets the proof from design. The three arguments are formally identical. The conclusion of the Kantian criticism is similar to Hume's. There are no values which by substitution render the argument valid. The awareness of the datum, thirty pieces of silver, is quite different from and does not argue that one has received the gift of that amount.

The idealists, gravely concerned to establish some criterion of truth which could be applied to ideas alone, have answered this criticism by identifying the object and the idea, thus relieving themselves of the obligation to account for the relation of one to the other. It has been recently pointed out that Saint Anselm found both idea and object in immediate experience, and that any adequate

idea and its object find their identity there. On this basis there seems to be a suggestive analogy between the religious experience of the mystic and the everyday experience of the ordinary man—at least for an idealist. But this does not solve the problem of objective reference, it moves the previous question. It is hardly likely that a realist would accept the point.

Current theories of objective reference seem to be in the ontological predicament. They presuppose that knowledge is a triadic relation between knowing subject, mediating term or datum, and existing object. The older formula needs only to be expanded to include the ego. It will then fit the current problem. We then have the triadic relation R (ABC) where A is the knowing subject, B is datum, idea, essence, mediating term, etc., and C is the existing object. The crucial problem is still ontological, that is, to determine the nature of the relation between idea and real object. We may classify modern theories by reference to their answers to this question.

First, there are the cosmological answers. These substitute some psychological defined datum for B; atoms, electrons, or some physically defined entity for C; awareness or the subject of an awareness for A. The validity of the objective reference is based on some causal relatum substituted for R.

For instance, I am aware of a sensum which is related to a physical object as effect to cause. I, therefore, may infer the existence of a physical object. Physical object has taken the place of the deistic God of the cosmological proof.

Then we have the argument from design. *A* is a psyche, *B* an essence, *C* a material object, and *R* is faith—though not Saint Anselm's exactly. I, as an organism, receive a "shock" and, as a spirit, experience an intuition of an essence that points to an object in such a faithful way that my behaviour generally leads to success. I am, therefore, an intelligent being knowing an object.

In addition, there is a class of theories which approach an analogy with the pantheistic tendencies in medieval thought. *B* is an aspect belonging to a system of aspects and related to them in such a way that awareness of one aspect justifies one in inferring other aspects, all of which constitute the real object *C*. *R* is any systematic relation. God is immanent in his manifestations.

For us the problem involved in this discussion is that of legitimizing entity hypotheses. Our answer is that entities are parameters taken in extension and parameters are terms in discourse, or possibilities. Inasmuch as entities are their logical offspring

the question of their correspondence does not arise. How far systems of parameters correspond with the actual as differentiated from the scientifically real is the real question of correspondence, and we are avoiding it only that we may finish our account of possibility and state the question more completely.

To quiet fears and remove misapprehensions we may say that scientific possibility is not all science; like esthetic possibility it is only the intellectual content of an art or an experience. Science as an art or an experience is an attitude functioning in a process. That is its abiding characteristic. The formulas, laws, and systems that it precipitates are its own ghostly memorials. They may be true or false; it is hardly appreciative to ask the question. They are hypotheses, imaginative journeys, visions of another world; they are systematized, co-ordinated, correlated possibilities.

However, the attempt to give this world truth and reality has been persistent and desperate. The scientific revolution, which has been going on for three hundred years now, gave people a certain kind of madness. The otherworld was just around the corner and they could tell all about it. Madness makes philosophy possible. So we have an attempt to shoot the moon, to bring down the final formula of possibility. To that we now turn.

CHAPTER III

ABSOLUTE POSSIBILITY

ALL fairy stories open, if not explicitly, then implicitly, with the magic formula, "Once upon a time" . . .; scientific hypotheses introduce themselves with as "If". These are the threshholds of the many mansions of the otherworld. But the child and the half-initiated scientist are not content with the mere starting point and a direction to travel. Most of us unfortunately are children and half-baked scientists, and we want to know not only where the entrances to the otherworld are, but also how far we have to go to take its measure. At certain times the demand is so loud and insistent that nothing will do but to search out an answer. A large part of the history of philosophy is the record of attempts to survey paradise.

It is one of the main aims of this essay to point out a fallacy that is presupposed by any such attempt. The fallacy is usually presented most appealingly in fairy stories ending with ". . . and they lived happily ever after". In science the entities discovered show a certain aspect of eternity by reference to which the sophomore claims

absolute validity for his prediction. Some becoming frightened by the uncertainty, yet heartened by the vastness of already discovered possibilities, see in the further extension of the field an approach to the finality they so much desire. They point out the finality and then spend their time in measuring their position with respect to it. Thus finality is still in the realm of the possible, although it is its furthest boundary, it is claimed. Therefore, I have given it the name: absolute possibility.

For us absolute possibility means the parameter of all other parameters, that is one whose field of variability would include all that is conceivable. There seem to be two ways of going about the search for it. One way presupposes that a certain number of parameters are already determined and there will be at least one whose field will include all those that at present are known. This might be called paradoxically the relative absolute and is usually sought in current scientific theory. The other way is so-called a priori. It takes a notion of parametric order or system, and choosing what seems to be its essential characteristics as norms, posits a system which shall perfectly fulfill these requirements. It calls this the absolute. If we make it an adjective qualifying possibility, one can guess what we may be about to say regarding it.

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First, let us examine the notion of a relatively absolute possibility. This is very common in the more elaborate scientific systems. Just at present two rival branches of physics, telescopic and microscopic, are running their first parameters as candidates for king parameter. The theory of relativity presents certain fundamental equations in terms of a very small number of variables, which, if proper substitutions are made, will express the motion of any particle, anywhere, at any time. Similarly the theory of atomic structure is presenting certain formulæ which, it is claimed will express with certain substitutions the same notions as are expressed by the relativity hypothesis. However, cautious scientists are careful to warn the untutored from supposing that the problem is easily answered, or perhaps answerable at all in any final way. The reasons for this caution are to be found by a closer examination of parametric orders.

In the logistical approach to the study of systems the definitions of the parameters are given in postulates and primitive ideas, all but one, which is merely named by a letter, usually *K*. It is not hard to see why this one parameter is left undefined. "One has to start somewhere" and no matter where one starts there will be always this undefined parameter. That does not mean, however, that it is unknown. Usually it is a common

sense notion denoting familiar things, or it is a technical idea which has become familiar by use. It should be noted that there is no reason why any given idea should not be defined or cannot be defined, but nevertheless it remains true that any given system of parameters must start with an undefined parameter.

Students of postulate theory—that study which deals with the art of making postulate sets for systems—are concerned to find a small number of postulates from which the given system is deducible. They recognize two criteria for such sets (1) that they should be *independent* and (2) that they should be *complete*.

The first of these is really a criterion for economy of expression. It means that one need not give a definition of a parameter which is obviously deducible from or implied by one already defined. Any such logically redundant postulates would be called dependent; non-redundant postulates are called *independent*. One can see how this reduces the number of postulates necessary for a given system. The other criterion is more important. It means that the definitions given in the postulates must unequivocally determine directly or indirectly every parameter in the system. The postulate set is complete when it "covers" the system in this way.

These criteria express two motives in logistics, (1) economy of expression and (2) coherence of system. Together these motives lead the searcher to that ideal of both economy and coherence, the comprehensive form of a system, or the system function. This is what we have called the king parameter, or the parameter whose field of variability contains all the other fields in the system.

One can imagine a feudal society which would pretty well illustrate what is meant by a system. First, a king having full powers over a certain territory; then dukes and barons, counts and viscounts, each under the other and each over still others until we arrive at the serfs who are still over the land and animals. Postulate theory is like theories of sovereignty trying to define and explain the rights, powers, and duties of the monarch and his immediate court, i.e. the base and postulates.

The problem becomes crucial when fields overlap and the underlords quarrel. The state of the realm of possibility is usually war, and the part that most insists on law and order is most unpacific.

The solution of the problem of sovereignty is usually by treaty as it is at present between relativity and the quantum theory. In astronomy physics follows Einstein; in atomic structure it follows the quantum

theory. However, logistics is restless in such a state of affairs and its usual method is to bring the two or more king parameters under one higher parameter; in other words, to define the given indefinable in terms of a higher one. The systems combine [redacted] a sort of Holy Roman Empire.

This super-king-parameter I call the relative absolute. The search for it is always within the realm of scientific possibility and its work is the unification of "scientific knowledge". For science its importance cannot be over-estimated.

Sometimes this, like other parameters, is taken in extension and we have a universe of nature on our hands. One is usually humbled by contemplation of it or grows conceited over his ability to think of it and thus "have power over it". (This last is a pun, "power" being a derivative of possibility etymologically.)

The theories of relativity have rendered this relative character of systems more clear for our understanding. It is said that we choose the axes of reference which will be most convenient for the systematic expression that we have in our physical systems. The principle of relativity is found relevant in any science and usually has a clarifying effect when it is introduced. However, there have always been some who consider such relativity vicious. They say

the principle itself is an absolute Absolute and ■ not merely a king parameter. It pretends to be final and definitive. But it cannot be so if it states merely the relative aspect. That alone is self-contradictory, the very extreme of sophistry. Its relativity is anarchic without a fixed reference, a permanent and necessary ground.

There were many attempts to define such a conception for science, for instance C. Neumann's "Body Alpha". Science has had many such dynasties. Whenever scientists succeeded in defining them adequately enough for their own uses, their inner unworthiness for their royal position was made plain. Einstein's work has been a warning to all absolute monarchies and most of them have heeded it and entered the constitutional stage, where systematic relativity reigns under law.

Before science achieved this reform philosophers were intrigued by the notion of an absolute and the possibility of defining it by pure reason. The most useful concept around which to organize such an effort was that of an *ens realissimum*. In medieval terminology this was a being of which all possible positive affirmations were true. For Spinoza it was a substance having an infinite number of attributes. For Leibniz it was only the notion of a complete possibility or a possible world, best defined in terms of the

laws of thought, where the emphasis is put on the law of excluded middle. Such a possibility would include one of every pair of contradictory propositions that can be made. In terms of parametric order, there is one parameter which determines the condition and variability of all other parameters. A system which fulfills this requirement would be a possible world—the perfect system. It is the perennial revival of this idea that has kept the ontological argument alive in philosophy up to the present time. The tendency to include existence as a predicate tempts the unwary. We escape this pitfall at present by keeping in mind that we are dealing with mere possibility.

What then are the a priori characteristics of a possible world?

In the first place it must of course have all the necessary characteristics of an ordinary system. It must have self-consistency and coherence. This is taken care of by our notion of parametric order. But there must also be a totality contained or determined by a possible world. The demand for totality combined with coherence means that any proposition or parameter not falling within the domain of the parametric order is at least compatible with that order. At first sight these seem to be easy requirements to fulfill. But on closer examination it turns out that there is a downright conflict.

The principle of totality like an absolute monarch must choose between the authority of divine right and the obedience of his subjects. If he enjoys the former there is a revolt and defection; if the latter, he loses the universal power. For evidence of this conflict note the history of the major problems of philosophy inherited from dogmatic theology and social science, where transcendence and immanence of ultimates come to blows. It is the problem of evil in theology, of sovereignty in government and error in philosophy.

In terms of parametric requirements, it may be stated as follows: The parameter of parameters must have universal domain and yet retain the identity which constitutes its determinateness. Consistency demands determinateness and total inclusiveness seems to conflict with the differentiation and discreteness thus required. Any attempt at solution of this must face these two conflicting demands of the postulate of totality.

One class of attempted solutions follows Leibniz in postulating an undefined number of possible worlds. This is found necessary on account of the following considerations. Take a given system and add to it new propositions or parameters. Each will find a place in the parametric order or would be compatible with it and its opposite will be excluded. Thus this system might [redacted] on

assimilating new elements until it fulfills the requirement of having one of every pair of contradictory propositions. But the excluded opposites by this time have begun a similar systematic accretion of possibilities and each of these may grow to the required status of a world. It seems there is no end to the process of forming possible worlds.

This may be called the nebular hypothesis for possible worlds. Consistency and coherence are schematic principles found in half-formed worlds, having nuclei of propositions and trails of undetermined propositions attaching to them. Some of the propositions are taken as true, some as probable, and others not yet formulated. In the process of condensation and organization of such a world incompatible elements are thrown off and start new nebulae and the process goes on indefinitely. This indefinite multiplication is again the extension of the schematic principle of totality—our infinite universe of systems.

Another class of solutions follows the idealistic tradition. Totality is postulated and coherence is defined in terms of it. Every parameter or proposition belongs to one system and the contradictions and incompatibilities found in developing any system in accordance with this ideal are merely difficulties in the process of building one possible world, but they are necessary evils.

That they are the only way we have of differentiating identity conditions. However, they are only apparently contradictions. Such contradictions are not in the system, but appear only in the process of developing it, i.e. in determination of parameters. They are in that sense only apparent. This theory may be compared with the theory of progressive creation of the world out of chaos where differentiation and articulation are steps in the process, but the final product contains no discrepancy. It might be called the millenial theory of possible worlds.

But here, too, totality and coherence are ideal principles which guide thought in its work of discovery and are partially fulfilled, that is, found only in parts of the system at any given time. The spirit of the attempt at a solution is like Job. Though totality slay me at any given time, yet will I trust in it. The theory is essentially one of faith.

Thus the mystic is tempted to deny the adequacy of systematic order and assert the ultimate universality and completeness of totality alone. Totality is taken as a parameter, and then hypostasized as the Absolute, and intellectual salvation consists in apprehending this One and All to the neglect of its articulate development. God and his heaven are not even around the corner, they are just behind the veil of our partial discursive

imagination, which alone prevents us from living the life of the absolute completely. All possibility, or all power, is given to the King of Kings and we are his manifestations.

The argument in this chapter is based on the structure of parameters and the conditions of their discovery and determination. The identity condition of a given parameter is determinate, that is, it is a differentiation within the field of variability of a higher parameter. This means that there can be no highest parameter in any absolute sense. We can say that a given parameter is the highest of those yet discovered, but, if it is fully distinguished and defined, it must be a subordinate. In other words, the highest parameter is always to be defined, and in this sense is undefined.

Lowest parameters have a similar and corresponding character. They are determinate as differentiations or determinations within the field of variability of the next higher parameters, but their own fields of variability are as yet undetermined.

This sort of incompleteness is a radical characteristic of possibility; it might be called expansiveness. There is always a new highest or lowest parameter to be determined and defined, and when that is done, there is yet another. Pythagoreans and the transcendental idealist see in this a mystical significance which they call Infinity.

But this is intellectual imagination being untrue to itself. Pegasus may have his home in the sun and use the infinite sky for his pasture, but even there he travels the road, though it be of his own making.

CHAPTER IV

DEFINITION OF POSSIBILITY

THIS chapter will carry the examination of the concept of totality to a point from which we may hope to get a perspective, including all the vistas that possibility has opened to us. Totality is one of a family of concepts that have had a very stormy past in the history of thought. This family is headed by the couple, part-whole, and contains a large and active group of near and distant relations. We cannot hope to investigate all of them. It will be quite enough for us to handle if we try to discover the relations of possibility and the part-whole complex.

What we have to say may be summed up very briefly at the start and then the exposition will have point step by step. It is this: Possibility is the regulative idea for the analysis of wholes into parts. Parts are then possibilities or potentialities with respect to their respective wholes and systems are hierarchies of such possibilities. The regulative idea of possibility has a function like that of the spectroscope which analyses sunlight into its components which then are arranged in the spectral series of colours.

Shelley expressed this when he said that life—life in general or possible—was a dome of many coloured glass, staining the white radiance of eternity.

It is necessary to distinguish between two kinds of wholes, one is what we shall call the individual whole and the other the variable whole. These correspond roughly to what has sometimes been called the real and the conceptual whole, but our terms are better for our purposes. These wholes are distinguished by the nature of their constituent parts and the relations between these parts.

The individual whole is concrete, that is, every part, or part of a part, is uniquely determined. It follows from this that the whole itself is unique. Another way of saying the same thing is that such a whole is a constant containing no variable. This also is true of the parts. Or we may say in looser language that in so far as such a whole is logical each part is determined by the concept of the whole. This means that each part is necessary to the whole and that a change of one or more parts changes the whole or destroys it. Such a whole is completely determinate. An example of such a whole would be an individual thing.

The variable whole is quite different. In the first place, a variable whole is not

uniquely determined. ("Uniquely determined" is not here used in the mathematical sense. It connotes rather the uniqueness of concrete individuality.) It has at least one variable part, that is, one part that can be changed without destroying the whole. This means that the parts may vary within certain limits and only their relations remain constant. In other words, they are covariations involving fixed correlations. The parts of this whole are really content and the constant relations constitute its form. In this sense the variable whole is a possible whole in that it may be different by having different parts. If S may have different parts then it is not an individual but a collection of classes or possible parts having fixed relations between them and therefore able to represent various individuals

Furthermore, we find that within such a whole there is a hierarchy of form and content. Any given part is a form for its parts by imposing certain relations upon them and it is content for the next more inclusive part. Each part may be taken as a whole containing parts and supplying formal relations for such parts. Similarly the original whole may be a part for still larger wholes and this also is a variable.

Now the relation between the variable whole and the individual whole is what we shall call analytical equivalence. It is here

that the notion of possibility comes in. If we define possibility as a rule which says to take any whole as constituted of parts, then we can take an individual whole, apply the rule, and there will be at least one variable whole corresponding, or analytically equivalent, to it. On the other hand, if we define actuality as a rule which says to take any whole as the unique determinant of its parts, then we have passed from a variable whole to its synthetically equivalent individual whole.

Reasoning according to the regulative idea of possibility is scientific explanation. Or we may say that scientific explanation is the progressive analysis of an individual whole, the result being the discovery of a variable whole which is analytically equivalent to the original. This introduces the scientific observation and experiment that we omitted in our account of scientific possibility. Let us see now if we can restate our previous account so that it will agree with this. Let us see if our symbolisms are equivalent.

A variable whole is of the same form as parametric order. Relational form in the former corresponds to identity conditions in the latter and content corresponds to the range of variability. Subsumption of parts is the same formally as substitution of values. From this we can extend our theory of

implication according to the rules of substitution in terms of whole-part inclusion. If B is a part of A then a is said to imply b. when a and b are analytical equivalents of A and B respectively. This, of course, can be generalized so that, if C is a part of B, and B is a part of A, then, if a, b, and c are their analytical equivalents respectively, a will imply c. Substitution in parametric formulæ is based on such relations between whole and parts. If it were not there would be no more than an arbitrary ground for distinguishing valid from invalid substitution. In other words, there would be no criterion for valid inference within such a system.

Logicians are usually satisfied if they can devise a set of rules which will describe the process of inference. When asked what the ground of these rules is, they rely on self-evidence or on some pragmatic test. There is no doubt that such rules are in some sense evident, and certainly they are usually pragmatically useful, but new and puzzling cases sometimes arise to which old rules do not apply. In such cases, one has the choice of denying the validity of the inference, or of inventing a new rule. In other words casuistry is as necessary a part of logic as it is of ethics and a thorough-going methodology should include some account of it.

It is really the problem of induction, or in terms of our theory, the fixing of para-

meters. On this theory, induction is an analysis of an observed individual whole and the fixing of parameters is the result. The observed whole is completely determined throughout and is capable of analysis indefinitely by reference to the rule for analysis given in the notion of possibility, that any whole is made up of parts. On this basis we are justified in saying that there is at all times at least one variable whole analytically equivalent to the observed whole. Further, the three laws of thought are the rules for such analysis. "*A* is *a*" is a statement of the formal equivalence of system and observed whole. The law of contradiction demands a one-to-one correspondence between the parts, or parameters, of the variable whole with the parts of the individual whole. The law of excluded middle demands a complete analysis on the given base or form, *a*. These laws were applied as rules of inference within the system previously. As such they were permissive rules allowing abstract thought. It is now seen that they have a wider and more fundamental significance in the process of analysis. They are not only permissive, but also regulative, in that, taken together, they constitute a logical casuistry, the methodology not only for abstract thought, but for the fundamental analysis of individual wholes. In other terms this use of the laws of thought is the applica-

tion of the law of sufficient reason, which means in our terminology that every part of the variable whole belongs eventually by analytical equivalence to an individual whole which gives necessity to the connexions in the variable whole to which the part belongs.

Our theory leads to this conclusion: That implication holds only because of relations between the whole or part and its included part in an individual whole, and that inferences are steps in the progressive analysis of this individual resulting in the construction of a system which is constituted of parameters each of which is to be correlated with corresponding parts of the given or observed whole.

This extreme statement may suggest some of the uses to which the theory may be put. For instance, it interprets the problems that are supposed to arise from the separation of thought and reality as current difficulties in the process of analysis. These problems, however, have difficulties which demand a further justification of analysis step by step. In general this justification is given by the laws of thought as we have suggested, but in particular we have to deal with the vicious tendency in thought to hypostasize forms and treat them as entities. This is what has been called by Bergson and others "vicious abstraction". We have already fallen into that way of speaking

in talking about systems. We shall do well to qualify what we have said by criticizing the notion of two worlds that we started with.

For purposes of exposition we may tentatively treat hypostasization as confusion of variable and individual wholes. Instead of distinguishing between them and then asserting the analytical equivalence of the former with the latter, they are treated as of the same status. In other words, a parameter is taken as a constant merely, and thus becomes identical with the individual whole. Or, again, an analytical part is substituted for an observed whole and a universe of discourse is given an ontological status. Our criticism will consist in showing that these two notions are radically distinct and their discrimination is most important.

The fascination of aesthetic possibility is due in large part to this ontological charm. In the aesthetic experience where parameters are loosely articulated and often isolated because they are unfamiliar or disguised partial possibilities very easily take on the independence of the concrete whole. The result for the artist appreciator is a vicious sentimentalism substituted for aesthetic clarity. A reaction from this is often in a direction of an analytical realism which approaches the systematic elaborateness of scientific possibility. Midway between these

two is the contemplation of essences after the manner of Santayana and the intellectual imagination of a Rupert Brooke, when the form of the individual whole is distinguished but not detached from its roots in actuality. A single parameter can thus be isolated and yet not hypostasized. One may believe in fairies without endowing them with flesh and blood. The freedom of the esthetic possibility is a lawful liberty, not a drunken licence.

But sentimentalism in art is not as dangerous as ontology in science. Here ontology becomes a dangerous hindrance to rigorous method and practice. The danger here seems commensurate with the elaborateness of the systematic development, or the number of parameters organized in the system. One may doubt the real existence of atoms and electrons, but the naturalistic universe is overwhelming in its power, that is, its possibility.

Take the simple parametric relation involved in Boyle's law $pv = c$. Here we have a parametric form, call it K, whose constancy is expressed in terms of a triadic relation between p, v, and c. Most obviously pressure and volume are here formal analytic expressions for parts of a total observational situation which is expressed by the analytical equivalence of that individual with the form

of the equation. By simply referring to this formula no one would think of hypostasizing p and v and speaking of them as entities and yet pressure has been treated as a power or force, an almost animate force, just as electrons which appear in physical formulæ as parameters give rise to ontological arguments as the God of the theologian's formulæ did once. The naturalistic universe has reached so vast a scale of extension and is so elaborately developed that it is almost impossible to bring oneself to doubt its real existence, even though its individuality and wholeness have never been demonstrated or pointed out.

But the ontological imagination has its difficulties on a smaller scale, from which we may learn a great deal about its more ambitious construction. For instance, after analysis has reached the satisfactory determination of a number system and its parameters which have obvious references to some concrete observed situation, certain further analyses produce parameters such as the square root of a minus quantity which seem at first to have lost any reference to the original whole. The speculative imagination at this point immediately flies off to a Platonic empyrean peopled with absolute forms, eternal and unchanging absolutes, yet individual and determinate. This otherworldly flight is a clear case of hypostasis of

parameters, for the logistician can show how this is but a case of a more complicated set of relations than has been shown before and has a very definite reference to the actual whole.

The problem of this reference becomes more difficult as one goes on in mathematics to the theory of limits such as infinitesimals and infinite series. But here again it is only a lack of ingenuity that prevents the immediate insight into the analytical formal status which parameters hold with reference to their basic whole.

Mathematics, however, is not as liable to such misuse as some other disciplines. Thus for instance in physics, electrons and ether; in psychology, instincts and group minds are especially tempting. We have seen how world upon world is populated with parametric entities by the speculative imagination. Dynamic science revels in such phantasies, but here again the analyst can show how parametric order is using purely formal relations between definite parts of observed wholes and it is only the animism usually attributed to savages that is more content with occult forces than correlations of the concrete.

The criticism of idealism or realism as a philosophy is similar. Mind or matter is hypostasized and worshipped when they are merely terms in discourse, essences as free

from noisy existence as you please to make them.

By this time the bored or irritated reader is clamouring for something besides relational forms. Content must be accounted for and reference to individual, concrete actual observed wholes is, like most absolutes, a kit bag for all philosophic troubles. What has our theory to say of contents? First, content qua content pure and simple is nothing. Our theory makes content relative to form. It is that which is left out when form is considered. Try to seize it alone and you will find it prettily formed, hence impure. Pure variability as it appears in the variable whole is only the as yet undetermined, that which has not yet been parameterized. All this is obvious and is not what the question requires as an answer.

What is our individual whole in which we find forms and relations? What is our actuality? We have described ■ as a completely determined whole, an individual. But are we not hypostasizing a parameter called individuality? The question ■ crucial and the answer will, I believe, be clear to one who has understood us so far.

We are not hypostasizing a parameter, we are analysing an entity. Individuality is a parameter in so far as it is used to analyse the entity, that is, in so far as it is thought

under the regulative rule of possibility, that is, to differentiate part from part in a whole. In so far as it is used under the rule of actuality, that is, to name a whole as given immediately, it is not a parameter but a name of recognition.

But recognition implies a criterion and a something which satisfies it. So this does and it is a criterion used by all careful scientists as well as the critical workers in non-scientific fields, though very seldom formulated by them. What is a fact, what is evidence, what will verify? That is the question and it is more often answered in practice than in formula.

Fact or evidence is a part of the actual whole which is immediately given in experience. The actual whole, as we have said, is concrete, uniquely determined, and individual. That is all, strictly speaking, that can be said about it. In loose language it is pointed out by terms taken from one or another analytic system and used demonstratively. A psychologist of the introspective school would call it a pattern or succession of sensations and images. An aesthetician might call it a design or harmony of lines, colours, tones, flavours, or textures. A physicist might call it phenomenon or even Nature. A theologian would call it divine presence. All of these are desperate metaphors attempting to exhibit that which is acknow-

ledged and is to be analysed; they are gestures rather than intelligible formulae. Poets and philosophers have often called them vicious distortions, and in their devotion to the individuality of the actual have uttered paradoxes and written poetic myths to the ineffable.

This is the road to mysticism, but a methodologist may pay his respects with a bow and proceed with his discourse. He will assume that the individual whatever its proper name may be is a whole, that it has parts, and that there are discernible relations between the parts. Finding these he abstracts or sets up a possible system equivalent to the actual whole according to the rules of analysis. Whatever is developed or discovered by such a method is a valid system. As long as the parametric system reproduces analytically the relations discerned in the actual whole without violating the criteria of analysis, the system is valid. A fact as a part of the actual is that which is analysed. It is that to which the parametric system is analytically equivalent.

Quite different from the question of validity of scientific analysis is the problem of its adequacy. These two have been confused very often. Validity means for us a faithful correspondence of system to actuality as presented in immediate experience. The development of systems by the process of

analysis and the constant reference of parameters to relations in experience insures a correspondence that we call validity. Adequacy, however, designates the problem of completeness of analysis.

We have seen how totality is satisfied in the formal aspect of actual experience, that is in its wholeness. But that is not what is meant by a possible world nor is it relevant to the question of adequacy. These demand a system from which no parametric condition shall be excluded. On our view this is a left-handed way of demanding the discovery of every last distinct part and relation in a given whole, or a system which shall contain as many parts and relations as does the actual whole. The answer is that such a system would be as completely determined as the actual; it would contain no variable and would, since it corresponds with the actual whole, be identical with it. No one would care to duplicate the actual world even if he could. But perhaps what the question really asks is whether there is any one part or relation that cannot be discovered in the actual whole. The answer here depends upon ingenuity of observation and analysis. In a sense it would better be countered with another question whether we should ever know of such a relation if it could by definition never be discovered.

These and a number of other questions would best be referred to a theory which goes with our view, a theory of the judgment, and we can best treat it by comparing it to the theory of the proposition as it is found in logistics.

CHAPTER V

POSSIBILITY AND ACTUALITY

The materials of a methodology are now before us for summary. Together they present the old problem of modality, and I am about to propose a solution in terms of a theory of the judgment, or intellectual intuition. I am not unaware of the metaphysical responsibilities one undertakes in giving any such solution, but I am convinced that at this stage metaphysics can be disregarded. The mistakes I have doubtless made will have to stand until the sort of criticism that leads in the direction of metaphysics can be made.

We have before us actuality, a form of totality which I have called an individual whole. We also have possibility, a form of totality which I have called a variable whole, or parametric system. I have asserted an analytical equivalence holding between these two forms of totality. In the course of the exposition of their natures, I have suggested various applications; for instance, to the problem of implication, inductive and deductive inference, verification, and finally the validity and adequacy of possibility

as a measure of actuality. Each of these involves a special application of the theory of judgment that I propose. I shall state the theory first and then make the applications.

There have been two great traditions in logic. One might write the whole history of philosophy as one great controversy between them. One is based on the assumption that propositions are the proper subject matter of logic; the other is based on the assumption that judgment is the logical unit. The former concerns itself with terms, relations, classes, and symbols; the latter uses the results of the first, usually criticizes them, and analyzes knowledge. The former, consequently, by its restrictions leaves out many of the problems that are considered of first importance in the latter and hands them over to other fields of study. Knowledge is said to be the subject matter of epistemology, which receiving this burden and falling outside of logic becomes psychological. Epistemology thus gives up the method of critical logic and cuts itself off from one of its chief allies. The logic of the judgment, on the other hand, takes on the problems of epistemology, and taking that liberty is apt to include metaphysics also. Both suffer from their responsibilities, one having trivial worries, and the other taking the universe on its shoulders.

It seems to me that methodology might cut across these territories and boundaries, and take what it can handle and no more. It is this that I shall try to make it do. The approach is from the problem of modality, which, if my statement of it is correct, is the locus of the controversies between the two traditions of logic. I think it offers a promising solution.

Individual wholes, it is said, are known by intuition. Variable wholes are known by understanding, or discursive thought. I have said that these wholes are analytically equivalent; or, more exactly, that variable wholes are analytical equivalents of individual wholes. It then may be said that discursive thought analyses the object of intuition or the individual whole. That is verbally correct, but hardly makes clear just what happens when an individual whole is analysed.

I should claim that no individual whole is known by intuition alone, and no variable whole is known by discursive understanding alone. They are two aspects of a single insight, or intellectual intuition. I would reassert the old formula with a slightly different meaning. "Intuitions without concepts are blind, and concepts without intuitions are empty." The meaning is to be taken from the context. Individuals without analysis are not known, and analysis without

individuals to analyse has no dependable ground for its steps.

In other words, the "knowledge" which we have in our great scientific systems is not genuine knowledge. It is mere possibility and has no form but the æsthetic or practical form it takes in discourse. The "knowledge" we have in our intuitions of individuals alone is not knowledge. It is also æsthetic or mystical. True knowledge is achieved only when ideas, or concepts, are discovered in or apply to individual wholes, in our terms, when parameters measure actuality. The special problems we have encountered in the exposition of the various kinds of possibility are points on the locus of such knowledge. We can clarify them by treating in turn the various aspects of the above theory of judgment.

For instance, if we examine the structure of possibility, we shall find implication a crucial difficulty. The structure of possibility is parametric order. We have chosen the parameter as the unit of possibility, not because it adds anything to the calculus of propositions, classes, or relations, but because it shows what these calculuses refer to. It may be well to review its description. A parameter is an identity condition determining a functional variation. It is this character which is symbolized in a propositional function. A parameter is also a

relational form between variable parts. This is symbolized in logic as a relation between classes. The values in the former case and the classes in the latter case are sub-parameters understood as constants. This relation of values to variables, or classes to relations holding between these is the heart of the problem of implication, and it is puzzling if taken from a merely logistical or propositional point of view. Rules of operation and inference can be laid down, but their authors have a hard time justifying them. Their arguments are usually circular and pragmatic in character. According to the theory of material implication, p implies q when either p is false or q is true. This is useful in application, that is in drawing inferences, but it is hard to give any more than a redundant reason for its assumption. The theory of strict implication uses the notion of impossibility; p strictly implies q when it is impossible that p is true and q be false. This can be paraphrased by stating it as follows: p implies q when it is necessary that if p is true, q is also true. But further reasons cannot be given. Neither of the originators of these theories would like or accept the solution I offer, because they are interested in logistics and the logic of the proposition, but it seems preferable to me.

If we recognize that p and q are propositions

symbolizing the subsumption of parameters and that parameters are analytically equivalent to complex parts of individual wholes, one case of the observed occurrence of such a whole will establish the implicative relation. For instance, if p be the compound proposition that A is a triangle and x, y, and z are angles of A; and if q be the proposition that $x + y + z = 180°$ (supposing these terms symbolize parameters), then the observation of an actual figure will establish the validity of the statement that p implies q. The rules of inference for both material and strict implication will apply. In cases where one of these rules does not apply, one will have the very instructive dialectical experience of finding that he has been talking about different parameters and different kinds of implication without distinguishing between them. This case which I have taken from Kant exhibits a point which is capable of much greater generality than he gave it. He thought it applied only to space and time relations that are dealt with in quantitative mathematics. I am saying that it applies throughout human thought. General systematic relations come with experience, and without either the relations or the experience, we would have no knowledge.

Possibility, as a regulative rule, that there is at least one variable whole for each individual whole, is based on this sort of

insight or intellectual intuition. Knowledge requires the fusing of modalities.

The problem of induction arises when we examine observation and emphasise the individual whole. How do we generalise from the individual? Here again the arguments are circular. Appeal to the principle of the uniformity of nature and probability always presuppose what they want to prove. According to the logic of the judgment the equivalence of a parameter and a part of the individual whole is seen. It is a case of measurement and insight. If this is objected to on the ground that prediction is not justified on this basis, the answer is that prediction is never justified if it means that cases of the law will again arise. Nobody knows that or ever can know it. If it means that if cases do again arise, they will have these relations between their parts, it is true, but tautological. Practical scientists admit this point and the history of science supports it. Possibility waits on the actual. It can never dictate its nature or behaviour.

The distinction between form and content is often misunderstood. We have said that possibility is the form of thought. This does not imply that it is the form of the actual and the actual is its content. The actual is not the content of possible form. Both form and content are products of analysis

and refer to superior and subordinate parameters, respectively. They are correlative terms synonymous with variable and value, relations and classes, and they occur only in the structure of possibility.

This leads to a consideration of the relation of actual and possible, individual whole and variable whole, which we touched upon when we spoke of the adequacy of possibility in discursive thought as an account or measure of the actual. Any individual whole will have an indefinite number of variable wholes analytically equivalent to itself. All determination of variable wholes involves negation, or the implicit recognition, at least, of other parameters co-ordinate with the one that is explicitly determined. For each given analysis there is, therefore, always some alternative mode of analysis possible and valid. This implies that no given system is identical with, or adequate to, a given individual whole. This has a bearing on the problems of chance and determinism. It means that there will be in the actual whole of which a given system is one possible analysis, features which are indeterminate and irrelevant to the system. The actual always contains more than can be exhausted in any given mode of analysis. Chance is in this sense a radical feature in experience, the ground for many a tragi-comedy. This indeterminate is often called contingency

and is confused with possibility. The distinction between them ought to be clear.

Neglect of this partial character of possibility or analysis leads to the fallacy of reduction, usually expressed by saying "So-and-so is nothing but so-and-so". A great many metaphysical theories which have been enunciated with great finality have been cases of this fallacy.

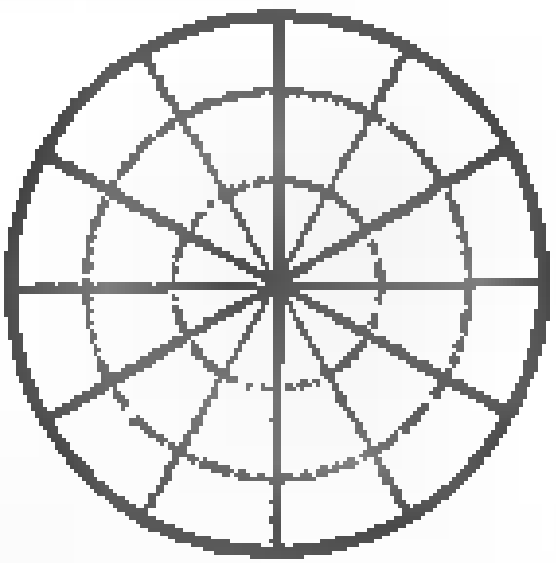
However, there is a meaning for the term, "possible world," that is relevant here. Suppose an analysis has been made on the basis of some parametric system which is in consequence stated to be analytically equivalent to a given individual whole. Such an analysis may be complete in the sense that the system of parameters has a one-to-one correspondence with the parts distinguished in the individual whole on the given basis of analysis. In other words, no part of the individual whole is omitted in the parametric system which is analytically equivalent to it. Although a further analysis is possible on a more refined basis and would result in a further elaboration of the parameters involved, this does not mean that the first analysis was not complete on its own level. For instance, if I state that in the circle O there are six sectors having the relation of equality to each other, my analysis is complete, in spite of the fact that I may divide each of these sectors into

two sectors that are halves of the original parts.

Suppose we call the circle in heavy faced lines O. It is possible to analyse the circle O, on a given base, F (equal sectors), into six 60° sectors. The analysis may be symbolized as follows:

(1) $O = F\ (S_1 . S_2 . S_3 . S_4 . S_5 . S_6)$

Then, by putting $S_1 = f\ (s_1 . s_2)$ where s is



a 30° sector, a further analysis can be made with the following result:

(2) $O = F\ [f_1\ (s_1 . s_2)\ f_2\ (s_3 . s_4)\ f_3\ (s_5 . s_6)$ $\ldots\ldots\ f_6\ (s_{11} . s_{12})]$

Both (1) and (2) represent complete analyses of O on the base F. They are what I have called possible worlds. In this case one can be subsumed under the other by substitution. These two possible worlds may

be said to be of different types but of the same order, where type refers to the character of the arguments of the functions and order refers to the function itself.

But now suppose we analyse the same circle O on another base, into spaces bounded by the dotted circumferences of concentric circles. These spaces may be called α, β, γ. We shall then have:

(3) $O \rightarrow \phi(\alpha, \beta, \gamma)$.

This formula represents another complete analysis or possible world of a different type and a different order from the preceding possible worlds in (1) and (2). Both function and arguments are different, and yet the individual whole analysed is the same.

Further, it would be possible to find another base of analysis, ψ, which would include F and ϕ and bring them and their arguments into one system. This system would be a function whose lowest arguments would represent the undivided spaces in the figure. These spaces would be atomic parts with respect to the base of analysis, ψ. In general, we may say that for every base of analysis, or king-parameter, there will be a set of atomic parts.

There seems to be no end to the discovery of such orders and types of possible worlds, given ingenuity and technical skill in analysis. I have chosen a simple illustration from Euclidean plane geometry, where special

parts are the results of analysis. With suitable changes, the method applies to any mode of analysis that gives rise to a universe of discourse. Each of these analyses produces a possible world, or complete set of possibilities. The problem of types presents no difficulties in the analysis of actual wholes. It is again one of those problems that go begging for a solution, as long as it is restricted to mere possibility, or the logic of the proposition alone. The various relations between the orders and types of possibility in the logic of the judgment presents one of the most interesting problems in dialectic. I refer the reader to Mr. Adler's work on *Dialectic* for more light on the method.

Further, the divergence in the bases of analysis has an interesting bearing on postulate theory. Postulates seem to grow in people's imaginations. It is true that they are found there, but their sources are again in judgments by which parts and relations are discriminated in individual wholes, and abstracted or set up as king-parameters equivalent to them. "Neutral entities" are merely parameters protesting that they have no prejudices.

The logic of the judgment thus adopts and cares for a number of orphan problems, and deals with them in terms of the analytical equivalence of possibility and actuality. Its essence is the recognition of this equivalence.

Actually, no implication is detected, no postulate defined, and of course, no verification consummated without the actual being present and revealing its relational structure *ad hoc*, as it were. The doctrine of intellectual intuition throughout the history of philosophy is a continuous witness to the recognition of this feature in knowledge. Any other theory would seem to be an imposter at large, postponing its appearance before the bar of judgment.

We are now in a position to elaborate this theory by a sort of one-sided discussion with representatives of the greater philosophical tradition. Suppose we call in Kant and Aristotle and tell them what their doctrines mean in our terms and bring points from their own writings to support our contention. If it appears in the end that we have exploited their meaning, we may apologise, but we need not admit that we have been refuted merely because we have misunderstood or misused the classics. Such philistinism is a part of the academic game of research and argument, and the process is justified as it has been in the past by the clarity and cogency of the result. The realism that demands what Kant and Aristotle really meant when they said certain things is quite irrelevant to our purpose and we shall not be frightened by it as much as by the necessity of our own intellectual problem. So if it is my Kant and my Aristotle that we discuss, and my conclusion has any merit in spite of the poisoned sources from which it comes, I shall make a votive offering to Fortune in the hope that she will again be as kind.

But before we go at this business of grave-opening we may as well state the wicked

intention we have. We are going to select quite unscrupulously what we can use to advantage, and add to our finds some of our own garments of thought judiciously adjusted and fitted to produce the appearance of lifelikeness. Such intellectual necromancy may carry its own vitality with it.

Kant is blamed for his transcendental idealism and Aristotle for his ontological realism. We would absolve them from their sins against high and disinterested contemplation, and since they cannot do penance for their sins, we will ignore these appearances of guilt, as we suppose them to be, and isolate if we can those parts of their systems that may be taken as foundations of methodology. We might call this their logic, but we do not mean to refer to their specifically formal logic as much as their architectonic or regulative principles, that part of their theories which may be called critical logic. With Kant this logic got hopelessly entangled with special psychology and the confusion led his followers into the idealism which we so cordially despise. With Aristotle these principles accumulated naturalistic excrescences that led to the adventures in occultism which so delighted his followers. Both of these are irrelevant it need hardly be said. We at least picture ourselves as hardheaded on these matters.

It will have become clear by now that this

essay is attempting to give some account of the anatomy of the intellectual imagination. It is in the light of this aim that we can isolate those portions of Kant and Aristotle that deal however indirectly with rational form as separate from particular applications in science, literature, or theology. In this light the shining thread of clear ideas that runs through both Kant and Aristotle, and is interesting to us, is unrolled from the spindle of actually observed experience into a web of rational possibility. For a Platonist this is the world of unchangeable essences so beautifully portrayed by Santayana. From the point of view of the critic of Platonism these forms or essences are the order discernible in the actual. This, in brief simplicity, is the historical statement of the thesis of this essay. Hence Aristotle and Kant, who were Platonists before they became themselves, are particularly relevant when they are facing the problem of Platonic dualism, and if we can catch them in the half-way stage just before they clicked into their historical niches we shall be instructed and enlightened in our confusion with the logistics and the systems of to-day.

CHAPTER VI

KANT

It is the right, good, meet, and proper thing to say that Kant was educated to be a rationalist and that he was awakened from such dogmatic slumber by Hume's sceptical attack. It is less conventional, but not less correct, to say that Kant was a man of his time, a time when conventional beliefs were losing ground before a new ideology symbolised but not wholly exhausted in Newton's physics. Kant was a humanist facing not so much an abstract system of possible worlds, but rather a confusing strife of rival theories competing for a place in the cultural sun. Brought up a pietist, educated to be a rationalist, and interested in experimental physics, he became the point of greatest stress in a field of contending forces. One who feels the similar stresses and strains in American life may be pardoned for expressing an exaggerated admiration for the large measure of success that Kant achieved in clarifying the issues in the confusion of the Eighteenth Century, and for looking upon the *Critique of Pure Reason* as a model in spite of its all too obvious

faults of obscurity and incompleteness. It has long been the writer's ambition to discover and disentangle from that special situation the intellectual tools that Kant used and to render them useful again in our own search for intelligibility. Radical changes must be introduced if this is to be at all relevant to contemporary thought.

It is often admitted that Kant's central problem was the a priori synthetic judgment. That is as Kant himself says, but it seems that too great attention has been given to that specific epistemological problem and a consequently exaggerated preoccupation with the psychological problems involved. At any rate, it is now necessary for even Kantians to admit that he did not solve the problems satisfactorily. The gulf between concepts and things still yawns as wide as ever—and philosophy students yawn from boredom with its discussion.

After some more or less prolonged wrestling with the texts the present writer has concluded that Kant suffered from an obsession with this question and that, as so often happens with rebels, his aversion to his Wolffian and Leibnizian instruction clipped his wings and narrowed his vision, thus preventing him from a thorough-going examination of the central doctrine of rationalism—that dealing with the concept of possibility. Nevertheless this concept

in the heaven of his cookery, even though its full action was hindered. He himself says that the principle of the possibility of experience is the *only* basis for the deduction of the categories. It seems that a fuller treatment of it at the right time might have shown the ontological predicament in epistemology a false problem and solved the more fundamental problem which is obscured by it.

At the risk of appearing impudent and possibly incompetent I should like to try to reconstruct the *Critique of Pure Reason* with possibility as the key concept. In doing this I need not feel obliged to support any special theory of time and space nor any set of scientific categories, but it will facilitate matters to [redacted] the Kantian categories [redacted] illustrations lying at hand. Also let it [redacted] remembered throughout that the problem is essentially humanistic, that is, to show some intelligible place and function for rival and conflicting scientific or speculative systems.

Figuratively speaking, possibility plays a part like that of the prism in the analysis of light. Just as sunlight is broken up into a manifold [redacted] colour by passage through the prism, so experience is referred to the concept of possibility and spread out into a thousand and one possible worlds which are to be understood only if they are known

to be so produced. The figure begs for interpretation.

. . . . . .

The notion I have to offer as a basis for a revaluation of Kant's work is very simple, so simple in fact that it is subject to misunderstanding from many points of view. It concerns Kant's particular way of facing the Platonic dualism, as I have suggested. The statement of his attitude may be given from the standpoint of any of a half dozen different problems and doctrines, but the one most relevant to our discussion is found in his treatment of the categories of modality, especially possibility and actuality. The crux of the matter lies hidden in the obscurity of the half worked out suggestions in the *Analytic of Principles* together with still more puzzling and suggestive remarks in the *Critique of Judgment*.

In the former we find "that which agrees in intuition and concepts with the formal conditions of experience is possible" and "that which is connected with the material conditions of experience (that is, with sensation) is actual". Then with all the labour of criticism represented by the second and third Critiques lying between, we find at the end of the *Critique of Judgment* (Part II, Division II, and Par. 76) "But now the whole of our distinction between the merely possible

and the actual rests on this, that the former only signifies the positing of a representation of a thing in respect of our concept, and, in general, in respect of our faculty of thought; while the latter signifies the positing of the thing-in-itself (outside the concept)". It is to be noted here that the two passages agree in general with regard to possibility, but there seems no obvious agreement about the actual.

It is plain that Kant was here not only verbally but intellectually confused. There is the actual "in sensation" and there is the actual "outside our concept". For the former only the synthetic unity of apperception can be invoked as a principle of order. For the latter an *intellectus archetypus* is constructed. These two actuals, like Euclidean parallel lines, meet only in the empyrean of transcendent ideas where all distinctions are lost. Sensation and the thing in itself has spoiled many promising philosophies, to say nothing of Kantian commentaries, for here lies the ontological predicament. Too often have young men in a hurry cut the Gordian knot and named one half of it actuality.

Kant was interested in three scientific traditions of his day, physics, psychology, and theology. All of these appear in Newton's *Principia*, and certainly Kant was influenced profoundly by the physics expounded in

that book. In psychology he was influenced by Locke and Baumgarten, as one can see in the *Transcendental Aesthetic*. In theology Leibnix and Wolff were his sources. In each of these sciences actuality would appear in a different guise. In physics it would be phenomena; in psychology, sensations; and in theology, the thing-in-itself. We can explain the different accounts of actuality in terms of these sciences and these influences on Kant. Still there is a consistent method running through Kant's treatment of them. It is, I think, summed up in the phrase, "the possibility of experience," as Kant himself says. It seems that in approaching these three fields Kant always asked himself one question. How is knowledge of this sort possible? and his search for an answer led him to an analysis of the "experience" on which he supposed them to be founded. The answer was always some variation on the formula, "the conditions of the possibility of experience." Kant never put his answers together, and I suspect he was right in not doing so, but his method has a consistency and steadiness that suggests the desirability of its extension. At any rate, I think highly enough of the answers to try to extend the method. That involves at the outset its critical revision, and then generalizing and elaborating it to cope with modern problems.

Let the various conflicting approaches to the actual in Kant (sensation, thing-in-itself, *intellectus archetypus*, apperceptive synthesis) be cancelled out. In place of them postulate a given whole denoting the immediate observed concrete datum, experience. Further, postulate an equivalence of this whole with the system of distinct parts in relation. Let this system represent the conditions of the possibility of the actual whole.

Now this system is the product of an analysis carried out in accordance with the regulative principle of possibility which we have formulated thus—a whole may be divided into parts. But this analysis could be made only by reference to some postulated "relational forms". This is Cassirer's phrase. Kant called them concepts of the understanding, latter-day logistics calls them system functions, I have called them parameters. These are at once principles which specify parts and thus serve as bases of analysis; forms relating parts, and thus constitutive of possible (scientific) objects; and variables defining universes of discourse, and thus rules of order for the development of systems. That all of these aspects of the relational forms are involved in the notion of possibility, or in the process of analysis, can be easily seen.

By supposing this, a reinterpretation of the

categories is made possible. My contention is that Kant was showing in the deduction of the categories that the scientific systems of his time were intelligible as types of possibility. A consequence of any success which he achieves in that direction would be that the categories become bases for analysis of experience into parts, and that any valid interpretation of the categories would show them as stages in the application of the principle of analysis. That the Kantian categories are not exhaustive I take for granted.

The axioms of intuition (that "all phenomena are, with reference to intuition, extensive quantities") are most obviously rules for analysis. For it is stated that extensive quantity is "that in which the representation of the whole is rendered possible by the representation of its parts. . . . All phenomena, therefore, when apprehended in intuition, are aggregates (collections of previously given parts) which is not the case with every kind of quantities, but with those only which are represented to us and apprehended as extensive". (This last clause is to distinguish extensive from intensive quantity.) This formula represents the first aspect or moment of analysis as we pointed it out above. In brief, it says—treat experience as an aggregate of parts.

The anticipations of experience represent

the next aspect complementary to the first. As Kant shows them they are obscured in a psychological formula concerning intensive magnitude of sensation and form part of a current controversy of the time concerning the dynamic interpretation of motion in physics. However, in the explanation which follows the formula, Kant makes clear that the principle of continuity is his chief concern. This principle is that no part of quantities, either extensive or intensive, is the smallest part (no part is indivisible). The anticipations of experience are here interpreted to mean that each part of experience can be divided into parts, and these parts again can be divided, *ad infinitum*.

The preceding principles are called mathematical categories and serve, as we suggested above, to specify parts by providing bases of analysis. The dynamic categories represent relations of parts. The general principle of them is: "All phenomena, as far as their existence is concerned, are subject a priori to rules determining their mutual relation in one and the same time." (A priori means for us "involved previously in the process of analysis".) Substance then is the permanent identity of the form relating the parts. Cause and effect and reciprocal causation are the asymmetric and symmetric relations respectively between the parts, upon which rules of implication are founded. Other

sorts of relations are discernible and might have been added to the list.

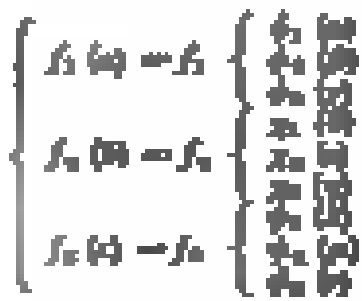
The modal categories are simply a summary of these moments of analysis. Possibility as a mere category (not a regulative principle) isolates the relational forms as Platonic ideas capable of abstraction and manipulation outside the content of the actual whole. "Actuality" (taken pre-critically) points out the parts (sensations) as instances or copies of the forms; we might say values satisfying the variables. Necessity is to be understood as hypothetical necessity—if we analyse such and such a whole then these relations will be discovered; if they are not found, analysis is impossible on the given base or category.

Following Cassirer the case may be symbolized thus: $W_0 \rightarrow F\ [f_1(a).\ f_1(b).\ f_1(c).\ f_2(d) \ldots f_n(z)]$ where W_0 is an observed whole assumed as equivalent to a totality having the form F and parts a, b, c, d, etc., related by f_1, f_2, f_3, etc.

But we have ignored references in the quotations to intuitions, space, time, etc. We have omitted consideration of them purposely, since in our account of Kant space and time become what is called in modern logistics special instances of serial order which are generated by successive applications of relational forms to a manifold of parts. These orders are not merely Euclidean space or merely one arbitrary

chronometric time. Whether Euclidean or non-Euclidean geometry shall be used will depend upon the character of relational forms or parameters chosen. Likewise with time-order Kant, being concerned with Newtonian physics and being unaware of other possibilities in this direction, took the order and arrangement fitted to correspond to the current physical concepts and thought of them as the only configurational patterns immediately given. In the light of subsequent developments we must question his findings, and, having done so, we find categorical immediacy is not characteristic of such forms, except as they are discerned in the actual whole which gives rise to many different forms of analysis, none of which can be considered for special favours. Intuition, again a psychological term which denotes a faculty for an immediately given, applies rather to the whole experience of the given within which many forms are discriminable.

We may sum up this interpretation of Kant by a diagram.



W_1 is the observed whole (actuality); a, b, c, etc., are parts having functional relations f_1, f_2, f_3 resulting from the first stage of analysis. They are subsumed or included in form F and maintain an order or arrangement (given by the subscripts 1, 2, 3, 4, etc.) which may be the Kantian schema of time or any more recently developed types of serial order. Each of these parts again may be analysed if and when an observed whole is found equivalent to it. Lower and lower orders of parts are thus developed having similar relations and orders.

For Kant the results of analysis were chains of conditions necessary for the experience of the real—his phrase is "conditions of possibility" and the real was to be understood by the discovery and discrimination of such conditions. But it appeared that once these conditions were found, and their relations formulated, they fell into series whose last terms were lost in an infinite regress. As Kant put it, Reason seduces the Understanding beyond the limits of experience and thus vitiates metaphysical knowledge. The prize which Reason offers is called the totality of conditions. Reason demands such a totality and promises it if Understanding will follow.

Each category furnishes a rule by which this search for totality of conditions is demanded and so at least for Kant there are

four such series: (1) quantity leading to infinity, (2) quality leading to simplicity, (3) relation leading to freedom, and (4) modality (possible and necessary) leading to a necessary Supreme Being. For Kant these series opened up the question of the possibility of metaphysics. We are interested in methodology. That will determine the form of our interpretation.

Having replaced Kant's manifold of experience by a given whole and his search for synthesis by a rule of analysis of that whole, the problem of the antinomies becomes the task of limiting the applications of our rules of analysis. Thus in the case of quantity as a rule of analysis, any given base of analysis will determine the number and magnitude of the parts and the dilemma of finitude or infinitude of the totality of the aggregate of parts is avoided. Likewise in the case of quality, or community as we have understood it, analysis may be pursued indefinitely and the parts resulting at any given stage are a finite number of simple elements on that level.

The ambiguities of the notion of cause confuse the Kantian position as given in his treatment of the third antinomy. We are more concerned with the notion of relations of which cause, if clearly understood at all, is a case. As we have said above, analysis is carried forward on a base of a relational form

which serves as a principle of analysis. Each form with reference to the forms of lower orders is unrelated relation (uncaused cause) and may be said to have an autonomy at least within its system. It is subject to no superior form and other relations are elaborations of it. Likewise a necessary Being an unconditioned condition refers in our interpretation to the form of forms, the king-parameter, which determines the parts.

But this evasion of the Kantian antinomies has not helped us to an adequate account of the notion of totality. It is the crux of our problem and if we can clear up its obscurities, it would be the solution of it. The *Dialectic* points to the difficulty, but does not show the way out.

In any intellectual problem, totality appears in three guises corresponding to the three stages of knowledge usually discriminated in historical theories of epistemology from Plato to Russell. First there is the object of observation (or belief), often called the individual substance. Second there is the formal system, and third there is the manifold of particulars. I have called the first, an individual whole; the second, an analytic whole or totality; and the third, an aggregate. It would be tempting to show how metaphysical systems get their biases from emphasis on one or another of these wholes, but we are not metaphysicians in our present

task. Suffice it to mention absolutism as resultant of the emphasis on the first, Platonism of emphasis on the second, and modern realism as emphasis on the last.

Now Kant pointed out that the antinomies arose from a confusion of the categories with the Ideas of Reason. For us that means a confusion of totalities (systems) with wholes. Mere relational forms are transferred from the analytic system to the concrete whole, which is for Kant the transference of the categories of the understanding to the thing-in-itself. We have treated the antinomies from within the analytic system and found no difficulty. But totality is thus only a supreme form, king parameter or relation. It is therefore merely a basis of analysis. It cannot be identified with the concrete whole. Kant, finding this to be the case, left the Ideas of Reason as persistent presuppositions of the categories, but labelled them dangerous roads to a merely postulated noumenal but unknown world. They are obviously the ghostly remains of Leibniz's possible worlds which came into Kant's thought as the totalities of the conditions of possibility.

From the methodological point of view the Ideas of Reason were for Kant rules for the completion of analysis. Since he thought that the antinomies demonstrated the impossibility of any such actual com-

pletion, they were merely ideals for science, always pointing to a further search for causes and conditions. They were regulative principles, rules for the successive application of the categories. Application of categories is on our view simply the analysis of the actual whole. The Ideals of Reason may then be reinterpreted in two respects.

First, they are concrete characters of the actual whole. "God" (in rational psychology, the transcendental synthetic unity of apperception) stripped of theological and metaphysical connotations is the character of independent substance that the actual whole has. "Immortality" (in rational psychology the transcendental ego) is the character of concrete individuality, or as some would say, the perspectivity of the actual whole. "Freedom" (in rational psychology the transcendental object) is the self-determination or unique determinateness of the actual whole. Together they mean that the actual whole, actuality, has a nature independent of and prior to analysis. In short, it is not to be confused with any relational form or part of the analytic system; and, conversely, that no parameter nor parametric system is an adequate determinant of the actual whole. Actuality must be distinguished from possibility.

Secondly, these Ideals of Reason serve to point out, in the actual, features the

recognition of which is the ground for the validity of analysis. In short, they say that the whole is made up of internally related parts. An adequate account of these is impossible, but, none the less, it is the business of analysis to approach such an adequate account in terms of external relations, the nature of which we have given in the account of parameters. If Kant had been an experimental physicist and known the actual procedure he might have treated these ideals as we have. If he had done so, he would have had a different theory of Imagination. He would have seen the ideas as regulative principles or selective rules for the primitive discriminations of the observer, resulting [redacted] what he called the synthesis of the imagination. [redacted] we substitute immediate experience, or awareness of the actual in observation, for imagination, then the free play of the imagination in harmony with the understanding and its "productive" and "reproductive" synthesis will be stages of analysis, or steps in the elaboration of parametric order.

The Ideas of Reason are regulative principles or standards for such analysis. The actual presents a concrete whole which is self-determined and yet analysable. This means it has parts, and these parts are related.

1. The actual is a whole.

2. The actual has specifiable features or parts.

3. There are relations between the parts of the actual.

Kant would speak of the first as the material of thought, sensation; I say it is the free play of imagination under the regulative principle to be derived from God, the whole or independent substance. Kant would speak of the second as the intuitions of time and space; I say it is the productive imagination under the principle to be derived from Immortality, the concrete in perspective. Kant would speak of the third as the schema; I say it is the principle to be derived from Freedom, or determinate relatedness.

This translation of the Kantian doctrine may seem prestidigitory. I have condensed a long dialectical argument which has usually had God and the Trinity for its subject matter and transferred the result to the methodology of science. It is stated here merely to make the account of Kant complete. I hope to develop it at length in connexion with some criticism of Mr. Whitehead's theory of prehension and Mr. Russell's theory of perspectives as an introduction to a reinstatement of aesthetics as the foundation of epistemology. This is by way of apology for the obscurity. For any who are acquainted with the Kantian doctrines

involved, a little reflection will reveal what I am driving at.

Thus the Ideas of Reason become the postulates for the three primary loci of thought—the whole, the totality, and the aggregate. From them three fundamental logics arise, and the solution of any intellectual problems depends upon seeing them as parallel and equivalent systems. This equivalence is to be found in the Judgment.

The locus of solution of intellectual problems is the Judgment. Here again we have a quasi-psychological term which has been raised to metaphysical significance by post-Kantian idealism. For us it is a descriptive term pointing to the equivalence of three elements of knowledge distinguished in our theory. Following suggestions in the latter part of the *Critique of Judgment*, we shall formulate it as the problem of modality, whose three categories correspond to our three points of reference; one might almost call them three axes of reference. The Judgment signifies the determination of the relation and function of any part with respect to each of the three wholes, and the equivalence of these wholes in the so-called "act of cognition".

Out of the actual whole (observed, intuited, or believed in) there are distinguished and selected isolated elements—possibilities. These are the commonly called data or facts,

the material of thought. The specification of these possibilities is expressed in the assertorical judgment, to use the Kantian expression for it. Scientific observation is often conceived as restricted to this selection, and theories of knowledge founded and limited to this basis. Logic treats them as particulars. Often time and space are referred to as the appropriate principles of selection or specification. For us these elements constitute an aggregate.

The same actual whole exhibits forms and relations that can be discerned, abstracted and held apart, making a system of so-called explanation. Metaphysicians of the Platonic type can see in them eternal essences and set them up as ideal perfections. Others see in them possible worlds (totalities) within which there are necessary connections or implications. These connections may be expressed in the hypothetical judgment or propositional function. For us, they are concepts or *generative ideas*, parameters or categories exhibiting a hypothetical necessity as relations. Kant has called them analytical-universals employed by the human discursive understanding. Modern logistics has investigated them in an attempt to formulate a calculus for them.

The rationalistic emphasis is on this sort of truth. The ideal of knowledge is a completed system of possibilities of such a

nature that every proposition would be true because it is an analytical proposition. This possibility becomes compossibility and by positing completion becomes metaphysical necessity. Coherence within such a system is the criterion of truth. The idealist takes it ontologically, and speculatively exhausts the totality. The Platonic rationalist, turning realist, hunts for facts to exemplify these perfections and sets up the correspondence criterion of truth. Kant's suggestion will help us at this point: "In fact our Understanding has the property of proceeding in its cognition, e.g. of the cause of a product, from the analytical universal (concept) to the particular (the given empirical intuition). Thus as regards the manifold of the latter it determines nothing, but must await the determination of the Judgment, which subsumes the empirical intuition (if the object is a natural product) under the concept." American critical realists talk about objective references of various sorts in place of the Judgment; Russell talks about belief or intension; Santayana speaks of animal faith. Realistic science worries about knowledge transcending experience. Kant goes on: "We can, however, think an Understanding which not like ours discursive, but intuitive proceeds from the synthetical universal (the intuition of the whole) to the particular, i.e. from the whole to the parts." Kant is here referring

to the intellectus archetypus, reverting to the Leibnizian God who will put Humpty-Dumpty together again.

Instead of any of these devices we assert the relevance of the third sort of modality and identify the intuitive understanding with the human observation of the actual whole within which the distinctions have already been made and from which possibility and necessity is to be derived. In other words, the Judgment is the recognition of the equivalence of the three forms of modality. This is the categorical judgment.

It remains to summarize the specific correspondences in this equivalence.

The "totality" is the form of the "whole" exhibiting the necessary connexions of its "parts". It is the intensional aspect of the aggregate, performing a purely logical function, in this respect usually called implication. The aggregate is the content of the whole, also the conditions of its possibility. It is also the extension of the totality, holding the status of particulars in logic.

In other words, the Judgment is the recognition of a unique triadic relation between the three modalities. This relation may be analyzed into three correspondences in terms of the relations and their converses as given above.

This finishes our exhibition of Kant.

Lest someone think that we claim to be translating Kant's thoughts accurately and without change, we shall here summarise what we have said by stating simply what doctrines we have interested ourselves in and showing the substitution and revision we have made.

The most consequential change that we have taken the liberty to make is in our conception of actuality. In place of the thing-in-itself we have taken the concrete whole in observation; in short, immediate experience under the aspect of wholeness. That there may be a naturalistic universe or a spiritual substance we have not denied, nor would its existence vitiate the course of our exposition. But for our argument we have chosen observed being in its immediacy.

Positing this has allowed us to eliminate all the quasi-psychological terminology that would tangle our conception of the system. In place of sensation we have assumed that the "material of thought" is parts of the observed whole, isolated as conditions of possibility, and by means of this we have dispensed with the doctrine of the reproductive imagination.

The frequent use of an obscure notion of synthesis has given way to our general notion of analysis which produces parts and relations. So the reproductive imagination with its

temporal succession and spatial configuration has been displaced by the more objective serial orders to be applied to the aggregate of elementary parts. The synthesis of the understanding appears in relational forms or ideas generating the series under the guidance of rules symbolized in the categories.

The problem of totality as it appears in the antinomies is found to contain no horrors for reason if such totalities are recognised as stages in the analytic process which advances on given bases or rules. Any level or stage of analysis contains its own limiting rules; completeness and adequacy is relative to them.

The ideas of reason are regulative with respect to the analytical rules, setting the "axes of reference" for any and all intellectual problems. Instead of being speculative as well, they are descriptive of the actual whole which is analysed, and denote the starting points for analysis.

The difficulties arising from the doctrine of judgment are avoided by this formulation of the problem in that the three axes of reference become the three forms of modality of which the judgment, in its three forms—assertorical, hypothetical, and categorical—states the equivalence.

One may ask why we connect all this with Kant at all, if we transpose or even wilfully misconstrue his chief doctrines, such as that

of the category and the ideas of reason. The answer is autobiographical. I have come to the problem by way of Kant and I have found in these doctrines the germinal ideas of the theory which I have developed with its bearing on contemporary problems. Reference to Kant clarifies for me the final statement to a certain extent, and I hope it may for others. I am not pleading for Kant before a court of judgment. I am pointing out my sources.

Further, the Kantian doctrines cannot be avoided in a discussion of possibility. His work points to its central position in science and his so-called idealism, both in the Platonic and phenomenalistic sense, throws a great deal of light on what might be called the de-ontologizing of possibility.

Possibility here appears as the creative and systematizing concept that runs through discursive or theoretical knowledge, purged of all ontological impurities, rendering intelligible some of the more obscure dogmas that lay the traditional dynamism (Aristotle) open to the charge of occultism. The Black Arts get illuminated and sanitized by contact with the criticism whose source is in "clear and distinct ideas". On the other hand, the *a priori* of the rationalist becomes functionalized and limbered up, allowing thought to be imaginative as well as rigorous. The rigidity of logical necessity loses its

romantic and sentimental aura and gets put to work in human experience without losing its soul to the pragmatic demon. The intellectual imagination is focussed in actuality.

Still, there are problems left. It hardly seems that a theory like evolution or astronomical physics can be recognised as equivalent to the actual as it is observed. Such objections as these come to mind immediately and there are others. Curiously enough, Aristotle sheds more light on this than Kant. So we shall continue our policy of exploitation in Greek philosophy.

CHAPTER VII

ARISTOTLE

I WOULD approach Aristotle with much greater trepidation than I do if it were not for two things. One is a comforting remark made by an Aristotelian scholar of some repute. He said that he considered Aristotle the best of all philosophical disciplines because the student would be forced by the obscurity of the text to think out the problems for himself and would thus escape servility of mind. The other reason is that I have a problem well enough defined at the start to guide me through that terrifying jungle whence so few Aristotelian scholars have returned. In addition the enforced limits of my research and that incompetence, amounting to innocence, that I have retained throughout a fairly long training in philosophy may prevent me from being tempted by the way to leave my methodological problem for the enjoyment of speculative metaphysics.

After consulting the commentaries, like Zeller's and Grote's, I was tempted to translate portions of the *Physics* and substitute them for what I was sure would be my own garbled accounts of the Aristotelian

doctrine. But looking into translations like Prantl's and J. Barthelmy St. Hilaire's, I was convinced that my attempt in that line would be no more intelligible than theirs. I cannot read Aristotle from Brentano's point of view, as a disciple, nor can I hope to rival Bergson's originality in paraphrasing Aristotle, so I go to Aristotle with a student's problem. What does possibility or potentiality mean and what light can it throw on modern problems?

As I understand the *Physics* and the *Metaphysics*, Aristotle is there mainly concerned to find a consistent and rigorous theoretical account of change. He tries out traditional methods, much as a physicist with an open mind would do, finally deciding on his own formulation by a sort of logical pragmatism.

He recognises Plato and Democritus as the great authorities in preceding attempts at the same problem. Both of them started with what they called the flux and conceived of it as a sort of veil of appearance behind which might be found a reality capable of formulation in rigorous and dependable terms. Aristotle examines their theories and finds them wanting when they come to the issue of what we would call verification. They are not faithful to the flux which he calls actuality. Yet their doctrines are suggestive. So he starts over again and coins

new terms which will allow him to incorporate theirs, but will not draw him away from the concrete individual actuality into a realm of independent essences nor yet out into a blind rain of atoms.

His theory runs somewhat as follows: Change or movement may be conceived as a series of states, qualities, magnitudes, positions, or substances. As actually observed, these are in a continuum which is capable of indefinite division. At any instant some of these will be actual and others will not be. Assume then a substratum in which all of these may be conceived to subsist potentially. Then a movement will be the realization of some of them. The states that subsist potentially are potencies and the realization of them will be motions. In most general terms, movement is the realization of the mobile qua mobile, mobility being a substitute term for whatever potencies there are assumed in the substratum.

Metaphysically this is very different from either Democritus or Plato, but methodologically all three are similar. Suppose we assume, as we have before, that explanation is analysis, or reference of the observed actual to analytical terms. Then roughly speaking, a potency, an idea, and an atom are such terms.

A potency is what we call a property, a characteristic which the thing shows on

certain occasions and which is definable in terms of other things and other properties. It is realized under certain conditions. Our science for a long time consisted in classifying these properties and finding their relations, in other words, systematizing them. So it was for Aristotle. Science for him was the formulation of relations between potencies.

A Platonic idea is a logical term sometimes exemplified in the flux, and science was for him (Plato) the definition and dialectical manipulation of these ideas.

An atom for Democritus was an unobserved, but clearly defined, entity whose motion and configurations with other atoms conditioned the aspect of things given in sense perception.

One can imagine Aristotle inviting Plato and Democritus to enter his universe of discourse and discussing with them the advantages of his terminology. It would be a sort of methodological conference with the parties' metaphysics checked at the door. Aristotle would argue that, for the sake of science, they ought to be willing to drop their metaphysical preconceptions and work with him to put science on a common basis. Suppose they objected . . . then finally gave in.

Provided the conference did not end in a quarrel, the outcome would be something as follows: Plato's ideas would have to be

reduced to systematic concepts and a logic of relations founded upon them. Democritus's atoms would have to subject themselves to analysis in terms of the ideas, though still retaining their relative atomic indivisibility for certain relations. Then Aristotle could use his terms. Atoms would be potencies holding certain definable relationships to each other and the systematic ideas would function as a calculus for these relations. The whole system would be called potentiality. Science would then be such a system held responsible to data of observation in the flux of existence. Aristotle might further offer his terms, form and matter, for the ideas and the atoms respectively.

The problem would then be to establish working conventions for the sort of responsibility that would hold between potentiality and the flux which Aristotle would call actuality in observation. A great deal of Aristotle is the detailed examination of this problem as it arises in the separate sciences.

I shall not attempt to deal with all of these, but rather to bring forth two suggestive illustrations.

The first is his treatment of infinity in the *Physics* Book III. One recalls the many and various uses to which this idea is put in Greek philosophy and science. Aristotle reviews these, paying rather special attention to two of the meanings it had, the

indeterminate and the perfect. In his hands these are problems in measurement and he calls them the infinite of division and the infinite of addition, respectively.

The former, the infinity of division, has direct significance for the account of the continuity of motion. A continuum is that which is capable of infinite division and movement is such a continuum. If potentiality is to be responsible to actuality it must show ways and means for accomplishing the task of measurement in this case.

In spite of some obscurity, when he is concerned with controversy, Aristotle's method seems to be somewhat as follows: The process is analysis with respect to a principle of division. The difficulty is to find the proper principle. If one chooses what we would call a unit of measure, the analysis is made and discrete parts are the result. These parts are equivalent to the whole with reference to the specific principle of measurement chosen. But once made, the division is ended and the requirements of infinite divisibility are not fulfilled.

Another principle of division is chosen, this time a "proportion", as he calls it, say it is "one-half of the remainder", and as Zeno had said, the measurement cannot be completed.

These two principles can, however, be combined into a workable system of measure-

ment for the continuum if we make successive measurements with a given unit of measurement to which a "proportion" has been successively applied. Thus, if a line AB be a continuum and we measure it in inches, then in half inches, then in quarter inches, we have used a principle of measurement which if extended gives us infinite division potentially. This, I take it, is the principle of the infinitesmal calculus, and may be refined and generalised until it becomes Mr. Whitehead's principle of Extensive Abstraction. Aristotle would call such an infinite potential or would say that the infinite of division is ἐν δυνάμει.

That is, of course, a beautiful example of the use of parameters or identity conditions which develop serial orders of sub-parameters, and these are assumed equivalent to an actual whole.

The infinite of addition arose in a controversy concerning the perfection of being, the point on which Melissus and Parmenides disagreed. Melissus said that the sum of all being is an infinite magnitude. Aristotle sides with Parmenides, who said that it was finite. He took this side for the following reason. An infinite magnitude is developed by the addition of finite magnitudes. But these finite magnitudes are the results of a previous division of a given finite whole according to some rule of division which gives an infinite number of parts. The

infinite of addition is, then, a sort of integration of the infinite of division. It is also, therefore, to be understood *de dicto*. Melissus was speaking of potential being and Parmenides of actual being.

In short, one can say that infinity, thus defined, is a refinement of measurement giving rise to rules which regulate the measurement of finite magnitudes. It is a type of potentiality.

I have chosen this illustration because it gives us a clue to a method which Aristotle seems to use on every problem he handles. Although not all subject matters call for an infinite analysis, his method allows for it. The whole system of his sciences can be understood in terms of it.

The subject of a given science, whatever it may be, is assumed to be an actual whole. Then potencies are fixed and developed into a system of potentiality which is best understood as a system of metrics, sometimes quantitative and sometimes of other character. Thus the science of nature is the science of change, and substances, causes, and other elements denoted by means of the categories are potencies which explain given cases of change.

Even more generally the subject of inquiry may be assumed to be an actual individual thing for which a substantial form is assumed to be an equivalent. This is a king para-

meter for a system of sub-parameters or potencies. Such systems exhibit certain systematic orders and relations. For instance, the four causes may be represented in these terms.

The material causes may be represented by a separate and, at times, only partially defined potencies or sub-parameters. The formal cause may appear as the systematic relation of these potencies, or as a super-parameter. When the serial orders, developed by these parameters, are noted, the terms of the series will symbolize efficient causes. Finally, the actual datum or whole as individual takes its position in the formula as final cause. This fits into our formula:

$$f_4 \rightarrow F\,[f_1(x) \cdot f_2(x) \cdot f_3(x) \ldots f_n(x)]$$

where f_4 is the observed individual and final cause of the process, F is formal cause, x the material cause and the f's are the efficient causes. Further, these parameters are fixed by a reference to the basis of analysis or equivalence furnished by the categories, quantity, quality, etc. The elaboration of this in detail would be similar to the corresponding principles in Kant.

This may seem to be playing fast and loose with Aristotle's metaphysics; perhaps it is, but the requirements of a methodology demand such a formulation, I believe. It is one way of understanding Aristotle, or

thinking out one's own problems in the Aristotelian atmosphere.

One further illustration will make clear how important this method may become. It concerns the relation of eudaimonistic ethics and the faculty psychology whose origin is commonly traced back to Aristotle.

The soul is defined as the form of the body or we may say, that the soul is the formal equivalent of the whole man in action. If the actual individual in action is the subject of psychology, then the soul is a king parameter in a psychologic system. Analysis of special activities results in the fixing of parameters (potencies) or as Aristotle calls them after Plato, the parts of the soul, vegetative, animal, and rational. These are further analysed and ordered until we get a group of correlated potencies, the human faculties in a theory of human nature. Analysis of man in action issues in a system of parameters, or uniformities, as we call them.

Contemporary behavioristic psychology, taking the integrated individual as the subject of psychology performs a similar analysis. In addition, terms are taken from physiology, systematized, and treated as conditions of human reactions. These are elaborated until they approach unit capacities as limits which are recognized in the intelligence tests. This psychology can be envisaged as an elaboration of Aristotle's

psychology. It has often been pointed out that this is the case. This psychology is further incorporated in a system of biological evolution.

In the case of Aristotle, psychology is the nucleus around which he builds a science of human nature, ethically rather than biologically understood. Greek ethics, I suppose, is the foundation of our social sciences and our theories of human nature. The shift from psychology to ethics for Aristotle is accomplished merely by applying his psychological potentialities to a new subject matter presented in the good life of a man in action. Ethics is the science of a man living the good life or a men in felicitous action. The terms of psychology are merely transposed with appropriate substitutions. The faculties of the soul are still the fundamental parameters. Taken together they are a man's potentialities or disposition. Elaborations are carried out and new parameters, habits, virtues, character, and the like are fixed and asserted to be equivalent to the types of activity distinguished in observed cases of good living.

The *Politics* is essentially an extension of the *Ethics*. The good life is a social life, "man is a political animal." The social aspects of good human living are measured and formulated in potencies. These basic terms are still the axes of reference for our

economics, anthropology, social psychology, and political science.

A detailed account of these particular theories derived from and applied to Greek life as observed by Aristotle would not add anything to our understanding of his method. We have stated enough to make a fairly important point. Aristotle's theories are measurements of actual things. Potentiality is the analytic representation of actuality. Actuality leads and potentiality follows.

This, I believe, has been misunderstood by the quasi-spiritual descendants of Aristotle. The case may be put somewhat as follows: There are ambiguities in the text of Aristotle concerning the nature of substance. At one time substance is a substratum in which accidents inhere; at other times substance is an individual thing. The elimination of this ambiguity is crucial. Usually students take it as a dilemma and choose the substratum as the rightful holder of the title, "reality." What they have done is to take substantial form for substance and by so doing have made Aristotle a Platonist with the form leading up to the pure actuality, God, which is really the Platonic idea of the good. Such an interpretation makes a plausible historical theory. Some forms of modern Platonism and absolute idealism are the result of following this argument whithersoever it leads.

I prefer to make another interpretation on the basis of the methodological analysis that is here set forth. The individual thing is the actual substance; the substratum or substantial form is the potential substance, "separable in thought but not in reality," as Aristotle so often says. Actuality is observed individuals, potentiality is theory. Substantial form is the king-parameter of the system, and the hierarchy of forms are subparameters, refinements of the parametric order. Form and matter are correlative aspects, intentional and extensional, of these parameters or potencies. The individual or the actual does not fit into a system; the system fits it. Actuality is prior to potentiality in substance, in formula, and in time as Aristotle says. It is the whole within which forms are discerned and from which they are abstracted. Potentiality measures actuality.

Consideration of this interpretation would, I believe, still the worriments of Aristotelian commentators over doctrines like pure potentiality and pure actuality. They would not, like the ancient Pythagoreans and their modern disciples, the mathematical philosophers, place the infinite "beyond the sky" as Aristotle said; nor would others place it in the indeterminate of sensation or matter, but would find it with all the other happy refinements of measurement in the

clear and distinct understanding of experience. The atoms and instincts would be terms of discourse about natural change and human activity. Pure actuality would not be an exasperating ideal, but rather a vital and significant pattern in experience, most steadfastly grasped by the artist or the saint, and caught by the scientist in the intermittent flashes of observation.

I anticipate many objections to this version of the Aristotelian method, which I would have to admit before a court of impartial historical research. But the purpose and the direction of the movement of this essay should, I believe, have right of way. This applies generally; but there is one objection that I foresee that may be answered.

One may object to the slight attention I have given to actuality as a principle or form, and that after all, basic as it is for Aristotle's doctrine of teleology, is Aristotle's chief point of interest. My answer is to repeat the contention that Aristotle's persistent practice is to equate the potential with the actual aspect of his subject matter. They are his ultimates and divide the honour. Whenever it is possible, I have chosen to take the potential aspect as more relevant to the problem of this essay. As one ascends the hierarchy of the Aristotelian metaphysics, potentiality is transformed into actuality at each step. I have viewed the system from

within as it were, thus catching the potential rather than the actual aspects. This, I believe, is more revelatory of the method.

Viewing the system from above, from God's point of view, actuality would be most apparent and the resulting rendition would be a metaphysics. If I had attempted this I would have been involved in the tortuous labour of dialectic which I have purposely avoided.

Still something remains to be said about actuality for the sake of the methodologist. It appears to the scientific investigator as deus quatenus. Even here dialectic is required for a full account, but I have hit upon an adequate substitute for the wordiness that that would require.

Imagine Aristotle, the Greek, observing actuality, and let Rupert Brooke, who is more Greek than modern, speak for him.

The Great Lover

I have been so great a lover: filled my days
So proudly with the splendour of love's praise,
The pain, the calm, and the astonishment,
Desire illimitable, and still content,
And all dear names men use, to cheat despair,
For the perplexed and viewless streams that bear

POSSIBILITY

Our hearts at random down the dark of life.
Now, ere the unthinking silence on that strife
Steals down, I would cheat drowsy death so far,
My night shall be remembered for a star
That outshone all the suns of all men's days.
Shall I not crown them with immortal praise
Whom I have loved, who have given me, dared with me
High secrets, and in darkness knelt to see
The inenarrable godhead of delight?
Love is a flame—we have beaconed the world's night.
A city—and we have built it, these and I.
An emperor—we have taught the world to die.
So, for their sakes I loved, ere I go hence,
And the high cause of Love's magnificence,
And to keep loyalties young, I'll write those names.
Golden for ever, eagles, crying flames,
And set them as a banner, that men may know,
To dare the generations, burn, and blow
Out on the wind of Time shining and streaming . . .
These I have loved:
White plates and cups, clean-gleaming
Ringed with blue lines; and feathery faery dust;
Wet roofs, beneath the lamp-light; the strong crust

Of friendly bread; and many-tasting food;
Rainbows; and the blue bitter smoke of wood;
And radiant raindrops couching in cool flowers;
And flowers themselves, that sway through sunny hours;
Dreaming of moths that drink them under the moon;
Then, the cool kindliness of sheets, that soon
Smooth away trouble; and the rough male kiss
Of blankets; grainy wood; live hair that is
Shining and free; blue-massing clouds; the keen
Unpassioned beauty of a great machine;
The benison of hot water; furs to touch;
The good smell of old clothes; and other such—
The comfortable smell of friendly fingers,
Hair's fragrance, and the musty reek that lingers
About dead leaves and last year's ferns. . .
Dear names,
And thousand other throng to me! Royal flames;
Sweet water's dimpling laugh from tap or spring;
Holes in the ground; and voices that do sing:
Voices in laughter, too: and body's pain,
Soon turned to peace; and the deep panting train;

POSSIBILITY

Firm sands; the little dulling edge of foam
That browns and dwindles as the wave goes home;
And washen stones, gay for an hour; the cold
Graveness of iron; moist black earthen mould;
Sleep; and high places; footprints in the dew;
And oaks; and brown horse-chestnuts, glossy-new;
And new peeled sticks; and shining pools on grass—
All these have been my loves. And these shall pass.
Whatever passes not, in the great hour,
Nor all my passion, all my prayers, have power
To hold them with me through the gate of Death.
They'll play deserter, turn with the traitor breath,
Break the high bond we made, and sell love's trust
And sacramented covenant to the dust.
——Oh, never a doubt but, somewhere, I shall wake,
And give what's left of love again, and make
New friends, now strangers. . .
But the best I've known,
Stays here, and changes, breaks, grows old, is blown

About the winds of the world, and fades from
brains
Of living men, and dies.
Nothing remains.
O dear, my loves, O faithless, once again
This one last gift I give: that after men
Shall know, and later lovers, far-removed,
Praise you. "All these were lovely"; say,
"He loved."

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CHAPTER VIII

DYNAMISM

In the course of making a revised version of Aristotle, I rather casually interpolated some teleological terms which are usually associated with possibility when it takes on metaphysical significance. The metaphysics that results is often called dynamism; the term is derived etymologically from the Greek word which means possibility or potentiality. Perhaps the reason that possibility is avoided in contemporary science is the supposed bad company it keeps in metaphysics. I mentioned this in the Introduction in connection with ethics; it certainly calls for some more thorough treatment. This does not mean, however, that I am going to enter the field of metaphysics proper. I shall stay within the methodological universe of discourse in spite of the fact that I shall talk about metaphysical problems. What I have to say will be no more than a few suggestions for method in dealing with two problems of metaphysics; teleology is one of them, and that will involve the other, internal and external relations. Please note the warning that I am not expounding

a metaphysics and, therefore, will not give any complete treatment of these problems.

A superficial examination of the methods of Spinoza and Leibniz will supply a background for these suggestions.

Spinoza was a lens-grinder in an age when telescopes and microscopes were the newest fashion in scientific instruments. Spinoza may therefore be imagined to have had an interest in optical phenomena, and to have been aware of the beautiful and rather fruitful analogy between light and knowledge, and, if we may trust Plato, existence itself. We may suppose, then, that he expanded a simple analysis of light phenomena to the dimensions of a metaphysics of being. There seems to be some basis for this interpretation in Spinoza's letters, but one could have guessed it without such evidence.

Suppose he followed the method outlined in this essay. The parameters involved in his explanation of light phenomena would be "source of light", "light rays", and "things illuminated". These could be defined carefully and shown to have an order of dependence in which source "of light" would hold the highest, "rays of light" next lower, and "things illuminated" the lowest positions with respect to identity conditions and fields of variability. Relations of inclusion and subsumption might be expressed as independence, dependence, and

necessary connexion, so that one might say that illuminated things depend on rays of light and these flow by necessity from the source of light. If these statements dropped their special applications and were expanded, we should have Spinoza's metaphysics of substance, attributes and modes. The definitions in the first book of the *Ethics* would express the result.

By substance I understand that which is in itself and is conceived through itself. . .

By attribute I understand that which intellect perceives of substance, as if constituting its essence.

By mode I understand the affections of substance.

These definitions also express the relations of possibility and actuality in the judgment, which, like Spinoza's intellectual intuition, acts as a kind of lens bringing them to a focus in experience. Actuality is a substance having infinite attributes or essences which are systems of possibility, determining particulars or modes, as sub-parameters or potencies. Further, various interpretations of Spinoza make the confusion which I have pointed out between actuality and possibility. The naturalistic interpretation identifies substance with modes, and thus make Spinoza a pantheist; idealists make Spinoza an idealist by identifying substance with the attribute of thought.

But I am interested in the teleology in this system. Some will object to any association of Spinoza with teleology and quote the Note at the end of Book I of the *Ethics* to support their objection. I believe that is not relevant. He is there arguing against a misuse of final causes which was current in the scientific controversies of the time. Some supposed final causes were co-ordinate with and substitutes for efficient causes. As such Spinoza quite rightly said they are impostors. He is arguing against a misconception which is current even to-day among those who would reduce human purposes to particular neural activities in the body. Final causes are not modes, he is saying. We would say they are not sub-parameters. Rather they are essences or systematic functions of which modes or sub-parameters are particular and subordinate determinations.

Spinoza's teleology is formulated in Book V, where all the previous metaphysics becomes the means of a way of life whose end is the intellectual intuition and love of God. When modes by means of attributes are seen in God, their true nature is revealed as means for the achievement of values whose source is God. In our terms parameters are purposes organized in subordination to higher purposes which in the judgment are values in the individual whole of observation. If the

transition is not clear now it will become so in what follows.

We may imagine Leibniz to have started his metaphysics by generalizing another case of analysis, the development of the differential calculus. Given the problem of measuring irregular figures, the method of the calculus says to divide progressively the curve into smaller and smaller segments until you have reached infinitely small segments. If the general character of these can be determined in a functional form, and this is possible by means of the proper equations and their differentials, then you have a very accurate knowledge of the curve in terms of its smallest parts. Or this statement may be inverted by saying that you will have a very exact knowledge of each point of the curve in terms of its systematic relations with every other point. For the sake of simplicity I am not mentioning the difficulty in the notion of infinitesimals. It will be seen that this is very close to the application of the notion of parametric analysis, where an analytic system is assumed equivalent to an individual whole.

Leibniz may be imagined to have taken this case and generalized it to cosmic significance by substituting monads having perspectives of the universe or systematic relations with all other monads, for points or infinitesimals. These perspectives or systems

are the possible worlds which he substituted for the equations expressing the forms of the curves. God is the King monad and the Pre-established Harmony is His mind, the system of all systems. Here again is an alternative metaphor for expressing the actual whole (God), possible wholes (possible worlds), and the aggregate (monads). The metaphors would have to be revised to render them strictly intervalent with mine, and there are also some discrepancies in the logic. I shall again emphasise the teleology in this system and leave the rough analogy as it stands.

God is the final cause of the universe, and by the overflowing of His power transforms the world systems into a Kingdom of Grace, or a teleological system where every lower form of being is related to every higher form of being as means to end. The end of all things is the Glory of God. Such terms seem very far from anything we have said about possibility, but if the literary or religious terminology were eliminated and the intellectual framework left, we should have a teleological interpretation of many parametric systems analytically equivalent to an actual whole. From the methodological point of view we should have a teleological theory paralleling each analytic system which is discovered in our analysis of actuality. This is a commonplace conversion in ordinary

everyday thought, but its philosophic bearing is not easily seen. I believe it can be made clear in terms of our theory.

$IW \rightarrow F\,[f(x).\ f_1(x).\ f_2(x) \ldots f_4(x)]$.

IW = Individual whole.

F = Variable whole.

$f(x)$ = Parts of variable whole.

If we suppose IW to be a value, then F will be purpose, f will be subordinate purpose, and x will be means for the fulfilment of F which is analytically equivalent to IW. Or we may say, as we did in the chapter on Aristotle, that

IW is the final cause of itself.

F is the formal cause.

f is the relation of efficient cause.

x is the material cause.

The symbolism has these alternative interpretations. Are they justified in theory? The answer to this question takes us into metaphysics, but I shall try to keep the methodological point of view throughout.

Parameters by dialectical translation become relations in the metaphysical universe of discourse. A parametric system becomes a relation of relations of relations, etc. When they occur in logic, they are abstract, but in the judgment they are discovered as concrete characters, qualities, patterns, designs, and so forth in the individual whole. They thus appear to be realized possibilities.

Further, abstract relations are external;

concrete relations are internal. This will mean that when relations are abstracted they become external, or when the actual is analyzed external relations are discovered which are analytically equivalent to the concrete relations which are internal. That a given relation is internal will mean that it is constitutive of an actual whole; its identity depends on the whole of which it is a constituent. That a given relation is external will mean that it is an abstract relation in a variable whole, and may maintain its identity independent of any such whole. This is the metaphysical condition which underlies the distinction we have made between individual and variable whole, between actuality and possibility. It is the necessary condition for abstract thought, that is the isolation and manipulation of single parameters which we call reasoning.

Now these distinctions are relevant to the teleological interpretation of possibility.

$IW \rightarrow F\ [f_1\ (x).\ f_2\ (x).\ f_3\ (x) \ldots f_n\ (x)]$ may be written

$IW \rightarrow R\ [(R_1\ abc).\ (R_2\ xyz) \ldots (R_n mno)]$ We may substitute relations for functions. It will then be seen that R and $R_1, R_2, \ldots R_n$ may be equivalents of concrete relations holding within IW. If there are such relations, they are internal, and as such are values organized as means and ends. If they are abstracted they become external and are

spoken of as purposes or parameters indifferently.

If this is a correct interpretation of these formulæ, it seems that teleology is a valid interpretation of any explanation or analysis, but it is in no way an addition to any other valid interpretation except in verbal form. Logically or analytically, there is no difference between purposive and non-purposive explanation.

The current controversy over this problem rests on a fundamental misconception that purpose is somehow an alternative or addition to mechanical or mathematical analysis. Vitalism rests its case on the evidence of incompleteness and inadequacy of this or that mechanical explanation, and proposes the preferable alternative of entelechy or vital force. Mechanists accuse vitalists of bringing in occult entities, unobserved processes, and undefined conceptions to cover up incomplete analysis and to take the place of it. Both of these are futile arguments based on uncriticised and therefore misconceived premises, if I am correct.

Again, certain phenomena are classed as physical or material, and certain others as vital or mental, and we have what is called the bifurcation of nature. On our analysis this bifurcation is based on one of two premises. Either the distinction is between two types of explanation supposed to be

different, purposive, and non-purposive; in that case the distinction is not genuine, since any explanation, if it is explicit, will be both purposive and non-purposive. Or, the distinction is between two parametric systems. One system has a king-parameter with an identity condition and field of variability which is called life or mind, and the other has no such parameter. The issue in this case must wait for its solution to come from further observation and analytical elaboration. The common trouble is that the parameters are not clearly defined and the controversy is merely verbal. One could learn some methods of refining the parameters which are involved in this field from the mediævals. The issues at present are dialectical rather than scientific.

The most regrettable definitions of purpose are those based on the assumption that only minds have purposes. They probably derive their popularity from the design argument in natural theology, where the purposiveness of nature, as it was called, was evidence of an intelligent creator. One comment is enough for that: Intelligent minds may discover purposes, even their own, but it is arrogance to suppose that only they are capable of having purposes. Any individual that is analysable has a purpose, in fact has many purposes, and they are identical with the laws it obeys, or more strictly,

with the theories that explain its behaviour.

But the objections to purposive explanation are well made, or would be if they were more discriminating. Spinoza's argument on final causes, mentioned above, is a case of discriminating objection. Given any set of co-ordinate parameters, symbolized by variables of the same degree of variability under a common identity condition, the parameter represented by the function of these variables is the purpose but it obviously cannot be substituted for any of them, nor can the individual whose analysis these parameters represent be substituted for them. Final and formal causes should not be confused with efficient and material causes. For instance, if "instinct" is a parameter analytically equivalent to a given concrete act, it is not a substitute or rival term for neurological terms which may be proposed. With respect to the latter, instinct is a form and they are its content. Neither should neurological terms be exclusive of higher forms such as instinct or will. Neglect of such distinctions in parametric order opens the way for all sorts of confusion in contemporary science. They give rise to the "nothing but" kind of argument and the corresponding recriminations from the other side. Dialectic is sorely needed in such cases.

A similar confusion is the origin of the

tradition of dynamism in ethics. As I said in the Introduction, this tradition traces itself back to Aristotle's *Ethics*, which was a sober application of physics to human conduct. The confusion has occurred since his time, in fact recently, in the idealistic treatment of potentiality.

Aristotle said that the end of human action was happiness, and he was careful to say that happiness was a general rather than an abstract term. This means that observed cases of goodness also have the character of giving happiness; we should undoubtedly say value. His ethics is the account of how such happiness comes about, and it is given in terms of capacities, or human potentialities being realised. Happiness is realised possibilities, we are told by his modern descendants. But the content is from here on different, and the general theory in consequence takes on a quite surprising character. Where Aristotle was analysing human conduct, they are legislating its ideals.

The translation of the formula is made by a simple harmless-looking proposition: What can be ought to be. If one has a capacity, it ought to be developed; each capacity ought to be developed; all capacities ought to be developed. What, then, are human capacities or potentialities? Aristotle discovered particular capacities by analysing cases of human action. The idealist, on the

other hand, becomes speculative and goes in romantic search for possibilities. He finds that they are the sum total of what may happen. Since each of these has some conceivable relation to every other, they make a system in human thought. They are, therefore, human possibilities. If we apply the formula: what can be ought to be, the conclusion is that man's duty is to realize all these possibilities, and they are infinite. Man is potentially the universe, and it does not yet appear what he shall be. If this is not true of his empirical self, it is true of his transcendental ego. This is, to say the least, an ambitious ideal, but not too great for a romantic hero or a genius.

To be fair, I admit this is a rather bald and extreme statement of the theory, but it is no more than is claimed by implication in current theories of meliorism and progress. On my view, it is fairly easy to criticize.

The theory gets its start from the fact that a given individual whole has an indefinite number of alternative analyses. Each analytic system is founded on a specific base of analysis which has at least one contrary. Hence, any systematic integration of a known class of systems will be subsumed under a parameter which has in its turn its contraries. Possibility is radically pluralistic and apparently indefinitely extensible. This means that any given individual whole

has infinite possibilities. If my analysis of the judgment is correct, this is true, but it is no more significant than saying a given whole is infinitely divisible, or that the number of variable wholes analytically equivalent to it is limited only by imagination and technical ingenuity.

The idealist has made a verbal transition from this to the doubtful, if not self-contradictory, notion of a system of all systems, or the class of all classes, which I have called absolute possibility. The shift from empirical to transcendental ego is evidence of the recognition of this, but it is not an evidence of clear thinking. The contradictions and amphibolies involved in integrating systems are glossed over and romantic intent arrives safely at the absolute. Finally, the application of the categorical imperative in this context, magnifying the ideal and belittling the difficulties, leads to a faith in the immortality of the soul, an infinite time in which contradictions may be dissolved in dialectic and all possibilities may be realized.

Less ambitious attempts to apply possibility in this way qualify the ideal without denying it. For instance, the Freudian metapsychology postulates the subconscious as a high pressure reservoir of instinctive potencies. These instincts are distinguished and classified and finally they are all subordinated to two super-instincts, the life

instinct and the death instinct. Human action is the realization of these two rival and irreconcilable potentialities. There is always a conflict or tension between them and any given action becomes a resultant of forces in a locus whose formula is the greatest possible activity in terms of instinctive urges with the least possible restraint. The radical pluralism of possibility is here recognized, but the locus is still the idealistic ideal of full realization of all possibilities, though it is rather war-worn and docile. The development of personality is to be guided by this ideal. Again the search begins for capacities, this time within psychology which has been substituted for metaphysics. The result is a composite picture of the healthy minded man and we have the ethics of normality.

If the parametric system represented by psycho-analytic theory were fully elaborated, each bit of human behaviour would be explained or analysed in terms of complexes, which would be terms in the expansion of the life and death formula of the Freudian metapsychology. With proper observational data and logical restraint this would parallel Aristotle's doctrine of the Golden Mean, the resultant of the vices at the extremes of virtue. But at present the lacunæ in the data and the temptation of "psycho-analogy" leads the psychologist back into the idealistic

school of rhetoric and we have our cults of psycho-analytic ethics.

The analysis of possibility that I have made allows us in no uncertain terms to criticize and limit the sort of teleology to which this sort of dynamism leads. This analysis says that possibility is the measure of actuality and has a parametric structure. This means that the conversion of possibilities into formal causes, of ideas into ideals, is valid only in a judgment which analyses a given individual whole. Otherwise it is myth and romance. This is relevant to the application of any science, biology, medicine, psychology, or astrology, to human conduct. It also applies to having ideals or plans of future action, hence to programmes of social uplift, as well as to metaphysical and theological systems of ethics. Also the requirements of parametric analysis must be met. They are (1) that parameters (whether potentialities, capacities or ideals) must be unambiguously defined and (2) the limits of their variability, hence their application and extension, must not be violated. Then, purposive explanation and dynamism will have no more dangers than any other of equal rigour.

CHAPTER IX

CONCLUSION

"WHAT has concluded that we should conclude about it"! This now famous remark of William James is a warning to all writers on philosophical topics, and it is certainly applicable when the theme has been possibility. Nevertheless, I am tempted to conclude, at least, in the manner of one going home after an evening's conversation, romantically and unrestrained by the doubts and objections of opponents in the argument. Also, I have another excuse. Possibility has a romantic sound about it, and readers, if there are any at this point, will be disappointed if some definite possibility is not pointed out. I have such a possibility in mind, and although I shall have to deflate it at the end, it may prove amusing and possibly illuminating while it is being flown in the sky of speculation.

The essay itself is in a sense a conclusion, or a bundle of conclusions. It is the record of many evenings of argument with a small group of fellow graduate students at Harvard University. After many disappointments in the regular curricular study of philosophy, we decided to take our training into our own

hands. So we met on successive Sunday evenings to "follow the argument whithersoever it led". Six of us stuck to it for over a year, and, such as we were, formed a commonwealth of mind. It was of such a character that I hardly know who originated the ideas here set forth. None of the members of the group would like to be held responsible for them, since they were more often opponents than supporters of the conclusions that I carried away. So I will not name them, but what I have thought puts me in their debt, or at any rate, if I were asked to name my sources, I should have to mention these "beloved enemies" in argument before I gave a bibliography of the subject.

My conclusions are then at least partially stated in what has gone before. What they all come to I am at a loss to say. I am very much aware of incompleteness, both in detail and in comprehensiveness. The theory itself, if I am correct in some of the points I have made in its development, is only a possibility. It is only one of many modes of analysis. As such it is either very important, in fact more important than any recent philosophy I have read, or it is nonsense. In the face of such uncertainty I cannot lay down the law as if it were the last word. I shall have to confine myself to some imaginative suggestions for further testing of the theory.

One such suggestion is the statement of a project in critical philosophy. In short, it is a return to the doctrine of clear and distinct ideas. This doctrine once had a profound influence in philosophy and science. Descartes, Leibniz, and Spinoza used it in their examinations of the scientific issues of their day. It was fruitful in results. Descartes established a method which is still valid. Leibniz started logical inquiries which are still going on. Spinoza faced philosophical issues and offered a solution which, as philosophical systems go, has not been equalled in insight since. I think this was due to the persistent search for clear and distinct ideas to which these men devoted themselves. It was only when smaller minds misunderstood the doctrine and mistook it for a dogmatic metaphysics that it fell on evil days of misuse. However, as is the case with many ultimate terms, clear and distinct ideas were not always understood by those who used them. Some one has recently said that Descartes had clear and distinct ideas about everything except clear and distinct ideas. Certainly the texts are anything but clear when they deal with the doctrine itself. They take it for granted. I believe the analysis of possibility in terms of parameters is a start in the direction of making this doctrine intelligible and relevant for us. The further elaboration and

refinement brings us to the project mentioned above.

The idea of parameters needs testing. I have drawn in only the general outlines of parametric order. These outlines have been gathered from rather close scrutiny of a few cases of application. I have found that application to new cases brings out new features that were unnoticed in previous cases. Thus, both the applications to Kant and to Aristotle were not mere illustrations. They amplified the previous account. Similarly, applications to scientific theory uncover still other features. This is both disturbing and reassuring. It may be that the theory will break down in the next case; on the other hand it may continue to function.

In view of this the project is the further application of parametric analysis. It can best be envisaged in a programme of research which has two parts, one for professional philosophers and the other for laymen, that is, any one of us who have to be our own philosophers.

Suppose a group of philosophers with varied training and many interests properly distributed set to work on a *Summa Dialectica*. They, being philosophers, would be pardoned for setting off the history of philosophy for their special attention. It would be their function to treat the historical philosophies as if they were voices in the great conversa-

tion that has been going on for the last three thousand years. Subject to the limitation of documents and human fallibility in judgments of importance, a selection of arguments could be made that would include those that issue in clear and distinct ideas and would exclude those that did not. The criterion of clearness and distinctness would be conformity to the definition of parametric order. Consistency of argument would be tested by application of the laws of substitution in and expansion of parametric orders. Negative and ambiguous cases, of which there would be many, could be adjudicated by dialectic.

Such a *Summa* has obvious differences from previous examples. For one thing, it is more comprehensive than Abelard's *Sic et Non* and St. Thomas's *Summa Theologica*. There is more material available and the scope includes and goes beyond theology. Also, Abelard's *Sic et Non* merely started the dialectical process, stating issues, but leaving them as opposing opinions and doctrines. St. Thomas applied a metaphysical framework which only incidentally was revised by its content. A *Summa Dialectica* would build its framework as it treated new problems and subject matters.

It differs from Hegel's *Phenomenologie* in that it proposes no grand synthesis. If my account of parametric order is correct the

outcome would be a pluralism of systems with many forms of order in place of a philosophy of history cut to fit the triadic framework. However, the actual research might revise this conclusion.

The actual procedure would follow the description and analysis of dialectic given in Mr. Adler's book on *Dialectic*. Parameters having been discovered and defined at the start, would be referred to systems. These systems would then be differentiated, compared, maybe integrated or expanded; at any rate they would be criticized and clarified so that any one who cared to could find out what he meant when he talked about them. Our philosophers would have to be well trained in the technique and temperamentally adapted to the business of philosophical conversation, since such conversations would be the only basis for their collaboration.

The result would not be a history of philosophy, nor an encyclopedia of the philosophical sciences, though these might be by-products. It would rather be a map of the discovered world of possibilities subject to continuous revision as the affairs in the life of reason progress. It would show, like the Mendeleeff chart of chemical elements, the deficiencies of various systems at any stage of their development and would be a guide in the search for yet undiscovered

possibilities. The effect of such a *Summa* on philosophical work would be rather surprising. Verbal battles over the isms, the confusion of faith and understanding that we call dogmatism, and the modern contempt for historical philosophy might be transformed into sober and steady work under a developing critical standard. It is comparable to the ideal of international law and the League of Nations, and like them is a Utopia taken from Plato's *Republic*. It has been formulated before in philosophies of the absolute. It is *religio philosophi*.

The other trial by ordeal for parameters is more plausible and, I think, more important. It should also be carried out by the philosophical guild. It is the critical history of science. The sooner it gets under way, the better for science and philosophy. Most of our contemporary philosophies are naïve systems of metaphysics and cosmology built on the cheapest pronouncements of pseudo-science. Every month sees some new transubstantiation of atoms into angels, of ether vibrations into soul, and evolution into Deity. Even when their authors think and write carefully, their readers, even the intelligent and professional readers, jump the distinctions to solve the riddle of the universe. Scientists fall into the same error by waving aside all metaphysical queries, thus by

negation sweeping aside all but their own metaphysical dogmas. The price of wisdom is eternal criticism. The greatest body of uncriticised dogma we have to-day is science. It seems that the critical historian of science has a rather big task on his hands.

I am aware that histories of science have been written. I do not want to belittle the efforts of scholars who have entered the field. It is a tangled and confusing subject matter. But it must be said that no great light has been afforded. Some years ago there was an attempt to introduce a course at Oxford University, which would deal with philosophy and science, as *Litteræ Humaniores* had dealt with ancient philosophy and history. After careful investigation it was found that no first-rate work had been done in the combined fields, and the project was abandoned. This judgment may be softened by imputing it to Oxonian conservatism in educational policy, and to a certain ironic blindness to the fact that three centuries of philosophy have been filled with heated discussions of the validity of science, but a little consideration of this philosophy will show that it has little to offer of intelligent criticism, and on the other hand that scientists, except in a few exceptional cases, have shown little interest in exposing their presuppositions. Professional pride in specialized studies has led many to resent

what they call encroachment on their territories; academic reputations have suffered when rashness has ignored the boundaries. Consequently, it is only recently that there have appeared beginnings of a body of literature even to record the problems. One is told the dangers and, by indirect intimation, the vulgarity of the investigation. Meanwhile we have popular outlines of science and heroic rhetoric celebrating the lives of the pioneer scientists—I was about to say the *Vulgate* and the *Lives of the Saints*. We need a Spinoza to point out the distinction between superstition and reason.

Suppose our guild of philosophers, as well trained as may be at the start and increasing in wisdom as the study proceeds, set out to collect the information beginning, for the sake of delimiting the subject to manageable size, about the fourteenth century and ending when science stops—that is never. They would need a tentative scheme of classification and arrangements. Let that be derived from the theory of parameters. Let them repeat many of the early experiments; they are ignorant philosophers and need the humility that comes from such discipline. Then let them be critical, fearlessly and tirelessly.

The result would be somewhat as follows. Science as we have it to-day would appear as a tradition constituted of at least three

parts. First, there is a body of folklore comparable in magnitude and esthetic elaboration with the mythology of any historical culture. Second, there is the story of invention and use of scientific instruments and mechanical devices, which have, as we are often told, a most profound influence on our ways of life. The fragments of these two aspects of science make up our present stories of science. Thirdly, there is an intellectual tradition whose secrecy approaches that of the esoteric doctrines of Pythagoras and the Greek mysteries; this is mathematics and logic. This is nearer the essence of science than either of the others, and is never popularized except in the opaque ritual of the occultist and the university professor. In short, these three phases of science are the alternative symbolisms of parametric order, the parallel incarnations of possibility.

The task of disentangling them would require three kinds of philosophers, the post-philosopher, the humanist-philosopher, and the mathematical philosopher. All would need to be dialectically able and capable of intellectual collaboration. The problem of preliminary training for these philosophers might drive us to Plato's communistic education on a small scale unless the psychoanalyst could show us a short cut to the reviving of our graduate schools of philosophy.

CONCLUSION

The task of the poet philosopher is of course the most difficult. His field is perhaps the richest source of poetic materials that human beings have ever had. Lucretius and Dante tapped it on previous cultural occasions, but scarcely anybody has done it since. The writings of the scientists are strewn with metaphor and analogy of the most daring and marvellous sort. Each scientist seems to have a private and precious world of symbolic imagery which, far from being external to his so-called more sober work, plays a necessary part of the process of discovery and measurement. Descartes was directed by an angel to work out analytic geometry, Kepler was fascinated by sun worship and its doctrines, and he also wrote an astrological almanac for a living. Faraday transferred a religious symbol to the magnetic field, Newton shot imaginary cannon balls around the earth to rival the moon, and the idea of the carbon ring came out of the lurid imagery of a morning after a party. These are trivial and well known, but there are more obscure and important instances of illumination from old world lore and mythology, as well as the quaint comparisons of trivial everyday happenings, such as Watt's tea kettle and Boyle's springlike gases.

But the historian of science must be careful. Literary ornamentation and pedagogical tricks are sometimes mere illustration, and the critic

should be careful not to be misled by them. A great deal of the work in the history of science shows confusion of this sort, and the outlines of science are full of it.

However, apart from this, it is safe to say that poetry has a function here, both as history and as criticism. The clear differentiation of myth from the other aspects of science is badly needed, and scientists need not resent such autopsy, since it does not destroy a value but adds another dimension to their work. The epic dimensions of contemporary astronomical physics does not interfere with the sober accuracy of the observatory. The observer is no less a calculator because he also has an imagination. In fact, it is more likely that the poet-philosopher would have to be drafted from the laboratory.

But perhaps the most important and difficult part of the poet's work is the detection and expression of aesthetic form in science. Scientific monographs are not models of literary expression. This is due to a habit and convention of such long standing that the mere suggestion that science has an affinity with poetry is shocking both to scientist and poet. But there are signs that the convention is being broken down; not all of these signs are encouraging with regard to the quality of the poetry. Nevertheless, one is led to speculate on the forms of literature appropriate to the various sciences.

Physics is obviously epic, although it has only once been successfully exploited. Chemistry might inspire a sonneteer. Biology is inveterately dramatic, but it needs the proportions of the epic or novel for its more romantic reaches. Psychology is still comic with a touch of satire. Economics needs the satirical essayist, and the other social sciences can be whimsical or oratorical or moralistic as they are. If this speculation seems irresponsible, a glance at the other arts and their preoccupation with scientific subject matter will furnish a professional precedent, and comparison will show the relative backwardness of literature in the field.

The poetic version of science also serves to illustrate a philosophical point that I have tried to make at various places in this essay. Dogmatism is an attitude of mind that arises from a confusion of possibility and actuality. I have tried to show how this confusion is a false identification of parameters with individual wholes. Science, as it is expounded, tends to lead toward such a confusion. The arts are safer. Sentimentalism in art is condemned, but realism in science is praised; they are corresponding confusions. The literary expression of science, freed of the provincialism of the laboratory and the museum, would purge it of its realistic dogmatism and restore the scientific imagination to its home in the open where

it can keep company with other subtle and refined forms of the intellectual imagination. This is highly important if we are to save science from canonization and the crudities and vulgarities of arrogant authority. The doctrines of evolution and atomic structure are now being believed without being understood. Their literary expression would shift the emphasis.

The history of invention and the use of scientific instruments and devices is another matter. The Marxian historian and the pragmatic philosopher have from different points of view brought this to our attention. Both need the emancipation from social and political dogmas which the positing of science in those fields would bring about. They also need the discipline of attention to the details of their own doctrine, but they have outlined the task, and our humanist philosopher, with a little engineering technique, could follow their signposts.

The theory that all things are instruments should be accepted methodologically in its extremist form. No narrow interpretation of it would be sufficient to the task. Contributions on this basis should be accepted from the anthropologist and psychologist. Social custom, tradition, morals, as well as words, ideas, behaviour patterns, and emotional complexes go with the instruments of measurement and the machines of industry

to make up this manifestation of parameters. Cross-breeding and the mutual contamination of instruments form one of the most exciting stories in the history of science. We have heard a great deal about our scientifico-industrial culture, but few writers on civilisation have noted the light it throws on science itself. Science is supposed by some to have brought on a social and economic revolution. It would be as fair to say that the ways of society and institutions, just as truly as the single-handed workers in the laboratory, produce our science, selecting and determining its methods and theories. Science may, then, be described as the child of the instruments.

However, the use of instruments of precision and experiment are the more relevant features of this sort of history. From the tinkers in the pharmacies of Europe to the modern research laboratory and the Bureau of Standards is the story of the fulfilment of Francis Bacon's prophecy in the *New Atlantis*. The House of Solomon is the modern laboratory. Its ritual is important if we are to understand its oracles and to apply its rules of life. Many doctrines, which are so fundamental that they are almost sacred to the scientific movement, are simple accounts of miraculous discoveries that were made by telescope, microscope,

spectroscope, camera, heat engine, compass, dynamo, X-ray tubes, and the interferometer of recent fame. They could be expressed in rules for the manipulation of these instruments. At present, attention is called to the luck of the experimenter and the revelations of the secrets of nature on the dials of complicated instruments.

This leads to the third phase of science, the great esoteric wisdom of logic and mathematics. This tradition is the most imposing of all. It starts with the astrology of the Chaldeans, the surveying of the Egyptians, the number systems of Pythagoras, the science of Plato's Academy, and it is transmitted by mystic cults and experiments and engineering feats of men like Archimedes and Leonardo to Copernicus, Galileo, Kepler, and Newton. Probably the greatest refinements have been achieved in the last century. The advance is only now reaching its greatest acceleration. Whenever the thread of this rationalism is rediscovered there seems to be an explosion of genius. There seem to be good grounds for assuming that mathematics is the essence of science. All else is pseudo-science. This may be one of the illusions of historical refraction, but the story of mathematics nevertheless sheds a great light on the rest of science, giving order to the chaos of imaginative speculation and the varieties of manual and mechanical skills.

"Let no one enter here who is ignorant of mathematics." "God geometrizes." Nature is a book written in hieroglyphics and he who would unravel its secrets must know mathematics.

In the first place the mathematical philosopher who undertakes the critical history of the tradition must know logistics, that is, the notational devices and calculuses that form the actual structures of the mathematical systems. Moreover, his knowledge should include and go beyond the skill of the mathematician. He should be able to see through the formulæ in two senses; he should be able to think ■ terms of them abstractedly according to rule, and also see their symbolic functions as approximations to intellectual form.

But this is only a beginning. The insights which mathematical logic has made possible allows us to extend the domain of mathematics enormously. All that can be recognized as language is some degree of approximation to the accuracy and faithfulness of expression which algebraic symbols achieve, and can by the trained mathematician be recognized as varieties of mathematical elegance or its opposite. In other words mathematics is not confined to quantitative calculation. It is seen to be the science of relations in their widest extension. Orthodox mathematics is only more elegant and economical

in expression than its loser and more sprawling linguistic brothers.

Its history would fall into a dialectical framework, first on the verbal or linguistic level, where equivalent languages could be cancelled out, or absorbed into more efficient linguistic forms. In such terms the calculus of parameters would apply; systems would be differentiated and elaborated by expansion, and integrated by subsumption or substitution. By dialectic, the poetic and the instrumental histories of science would appear as alternative linguistic forms, their particular divergent characters eliminated, and the forms of intellectual imagination brought to their clearest and most adequate expression. In a sense the mathematical logician would be the master craftsman in the philosophical guild.

Perhaps it is now clear why the concept of possibility comes to be so vitally significant. In this history of science we would have the history of culture in terms of discourse or dialectic, of which it could be said that by it we come to know what we are talking about, ideas become clarified, but we never know whether what we say is true or not. It is the realm of that which may or may not be. That is possibility.

However, the reader may be objecting vehemently by this time. Like Glaucon in the *Republic*, he wants to know what sort

of a project this guild of philosophers is going to be forced to undertake. The answer is that this is a methodology writ large, a plan laid up in heaven, " which he who desires may behold and, beholding, set his own house in order. But whether such a one exists, or ever will exist in fact is no matter ; for he will live after the manner of that city, having nothing to do with any other."

To return to the introduction, this essay takes the position of the individual person confronted with a welter of diverse theories, claiming not only his attention but his judgment as well. They appear mutually exclusive and conflicting, especially when a present situation demands intelligent appraisal. He must judge. How shall he judge? The answer I have tried to give has involved a long journey through the realm of possibility with note-taking on the way. At the end I have outlined a Utopian solution—even if it were feasible, it would be a long way from adequate to the problem. If there is any suggestion for an answer in all this, it is the old way of critical philosophy, the search for wisdom by way of dialectic.

It is, first, the disentanglement of clear and distinct ideas, recognizable now as parameters. Their clear apprehension demands unambiguous definition which will establish an identity and, at the same time,

furnish a rule for application. This is the standard of what is to be achieved by dialectical criticism. The result is a knowledge, not only that a given idea may be true or false, but also when it may be true or false. In this sense, a clear idea is its own test of truth or falsity.

Secondly, these parameters are to be understood as products of the analysis of actual wholes observed in experience. They are therefore measures of actuality. This measurement is achieved in the judgment which is the modern term for the intellectual intuition of Plato and Spinoza. Knowledge is possessed only in such judgments. All else is intellectual imagination, of which our science to-day is the most significant constituent.

If there is a metaphysics of this theory it is not yet clear to me, except in a figure of speech. Experience is like visible light. As a whole it is the source of light; its parts are visible objects in all their concrete richness; ideas are reflecting mirrors and refracting prisms affording antiphonal understandings which are focused in immediate intuitions.

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